THE UNIVERSITY OF ALBERTA

SOCIOECONOMIC STATUS DIFFERENCES IN CHILDREN'S DISCRIMINATION LEARNING AS A FUNCTION OF THE REWARD AND INFORMATION FACTORS IN REINFORCEMENT

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Socioeconomic Status Differences in Children's Discrimination Learning as a Function of the Reward and Information Factors in Reinforcement," submitted by Malcolm Gordon Eley, in partial fulfillment of the requirements for the degree of Master of Education.

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ABSTRACT

The primary purpose of this study was to investigate the possibility that children of different socioeconomic status (SES) react differently to reinforcing stimuli. Specifically, the present study tested the proposition that compared to their lower SES counterparts, upper SES children make more use of the response-adequacy information inherent in reinforcement. Consequently, the reaction of upper SES children to a reinforcing stimulus should be relatively independent of the identity of that stimulus.

A visual-discrimination problem-solving task was administered to 128 subjects with an average age of 7.89 years (standard deviation .35 years). The study employed a three-factorial design with factors of reinforcement (candy vs. light signal), instructions (complete vs. no prior definition of the response-adequacy meaning of the reinforcer), and SES (upper vs. lower).

While partially supportive, the results were nevertheless inconclusive. Analysis of variance and covariance (IQ covariate) techniques yielded only one significant effect, an SES x instructions interaction. This interaction was interpreted as indicating that no differences occurred between the performances of subjects in the upper SES - instructions, upper SES - no-instructions, and lower SES - instructions conditions; but that the performance of the lower SES subjects suffered under the no-instructions condition.

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CHAPTER 1

Introduction

Glaser (1970) notes that one of the major research areas before educational designers and planners today is the interaction between individual differences and learning variables. He considers that the major emphasis in educational research should be in the discovery and delineation of interactions between habits and skills that the student currently has, and externally manipulable environmental variables. The results of such research would hopefully allow for the provision of optimal conditions for each student.

One criterion for the selection of individual and environmental variables for study should be that of availability. Time and cost economics are necessary facts of life in today's schools, and thus, perhaps regrettably, cannot be ignored in the development of future instructional techniques. Thus, while it may be of theoretical value to search for interactions between variables without concern for the overall economics of the school situation, it would be of little practical benefit. At least at this early stage of development, research should be directed toward changes that can be immediately implemented.

The socioeconomic status (SES) of the student is an index of his familial background. As a result of variations in the child-rearing practices of parents of different SES, the influence of reinforcement upon the child's learning would be

expected to be at least partially a function of SES. Since the reinforcement techniques used in schools are frequently related to teacher practices rather than the presence of specific physical materials and equipment, these techniques should be readily available to change. Thus it was to the interaction between SES and reinforcement methods that this study was addressed.

At the outset, it should be noted that while SES is an accessible variable it is also extremely global and nonspecific. Its choice for study could possibly be criticized in that research should perhaps be directed toward discovering those specific component variables that cause SES to interact with reinforcement. This criticism is well taken in that such studies are indeed worthwhile, useful, and necessary. However, it can be argued that they are adjuncts to, rather than replacements of, research into the overall SES variable. On the basis of a pragmatic priority, the latter is more immediately applicable.

Differences in the parental values and child-rearing practices among different SES groups have been well documented by both social psychologists and sociologists (Bronfenbrenner 1958, 1961; Gottlieb 1964; Kohn 1963; Reese & Lipsitt 1970; Sears, Maccoby, & Levin 1957; Tulkin 1968). Thus children from different SES families will have been raised under different physical and social conditions. From a social learning viewpoint (Bandura 1969; Bandura & Walters 1963; Staats & Staats 1963) they will have had different models upon which to base their

behavior patterns, and different stimuli to which reinforcing values have been conditioned.

One possible interpretation of the learning situation would indicate that there appear to be at least two major component factors involved in reinforcement. First, the reinforcing stimulus may possess reward value for the subject. As such, the reinforcing stimulus may be either primary and thus related directly to an environmentally induced condition such as hunger or thirst, or it may be a conditioned secondary reinforcer such as money, social praise, or task completion. Second, reinforcement can also act as an information signal. In this role, the actual physical identity of the reinforcing stimulus does not appear to be critical. Rather, the reinforcer is of value in that it informs the learner of the adequacy or correctness of his response.

These two components of reinforcement are not posited to operate separately. Any one reinforcing stimulus may be operating both as a reward and as a signal of response correctness.

It was the basic position of this study that as a result of their different learning opportunities, techniques and modes of reinforcement in the learning setting would differ in their effectiveness for children of different SES. Specifically, compared to his lower SES (defined by occupational status scales) counterpart, the upper SES child would be expected to have developed both a wider range of stimuli to which reward value had been conditioned, as well as more sophisticated strategies

of dealing with the informational content of reinforcement.

It was realized that in the experimental situation it would be extremely difficult, if not impossible, to completely separate the reward and information factors in any one reinforcing stimulus. However, under specific experimental conditions it should be possible to de-emphasize the potential effectiveness of each of these factors separately. This study attempted to provide such conditions in order that the interaction between reinforcement and SES might be further investigated.

CHAPTER 2

Literature Review

Reinforcer Effectiveness as a Function of Prior Learning Effects

A premise upon which this study was based is that the different physical and social environments that characterize levels of SES constitute different learning conditions for children. If such a relationship is in fact operative for SES in particular, then it should be possible to show a corroborative dependency between the effectiveness of a reinforcing stimulus and prior experiential factors in general.

For specific physical reinforcing stimuli, such a dependency has been demonstrated through satiation-deprivation studies. It has been shown that prior satiation decreased, and prior deprivation increased, the reinforcing effectiveness of such stimuli (Stevenson, Weir, & Zigler 1959; Stevenson & Zigler 1958).

The effectiveness of a reinforcing stimulus has also been found to relate to more general indicants of prior experiential history than satiation-deprivation. Miller and Estes (1961), using both money and response-correctness feedback, found that subjects rating low on achievement need made significantly more errors on a discrimination task than did those with a high achievement need rating. Leff (1969) found that high intensity punishing stimuli were extremely effective for six-, seven-, and eight-year-old girls. He noted that this may perhaps be

indicative of the fact reported by previous studies (e.g. Sears et al. 1957) that parents treat girls more nurturantly than boys, using indirect and nonphysical forms of punishment.

The effectiveness of social reinforcers has also been shown to relate to prior experiential factors. Similar to physical reinforcing stimuli, social reinforcers were enhanced or diminished in their effectiveness by prior deprivation or satiation respectively (Erickson 1962; Gewirtz & Baer 1958a, 1958b). Supportive or denigratory social reinforcement of a child by an adult resulted in the child interpreting a future lack of interaction with an adult as either denigratory or supportive respectively (Crandall 1963; Shallenberger & Zigler 1961; Stevenson & Snyder 1960).

From these findings then it was concluded that prior experiential history is related to the effectiveness of a stimulus as a reinforcer. The relationship appears to hold for both physical and social stimuli.

Basic to this study was the proposition that the different learning conditions inherent in the various levels of SES result in the conditioning of different stimuli as secondary reinforcers. Such a conditioning mechanism is dependent upon the facility with which originally neutral stimuli can be conditioned to possess reward value.

McGinley (1969) found that objects of the same color as a reward-preceding signal light on a learning task were

preferred significantly more often than would be predicted on the basis of chance. Thus, the existence of secondary reinforcer conditioning phenomena in humans gained support. In a second condition, no evidence was found of vicarious conditioning of the same color preferences, indicating that while it is still possible that secondary reinforcers may be learned vicariously, it would seem that the predominant mechanism is direct conditioning.

The opportunity to interact with a stimulus as a valued object appears to be a variable in the conditioning of that stimulus as a learned reward. Walls and diVesta (1970), investigating the conditioning of children's preferences, found that those subjects who had had more opportunities to rate a set of symbols expressed a significantly greater preference for a rewarded symbol than those subjects who had had fewer rating opportunities.

From these studies support was provided for the premise that originally neutral stimuli may attain learned reward value; that the predominant mechanism is direct conditioning; and that time spent interacting with a stimulus is a related variable.

The likelihood that a given stimulus will operate as a reward will be partially a function of both the range and extent of its conditioning opportunities. Since such opportunities will be indirectly a function of time, it would be

expected that any one conditioned reinforcer would be more effective in learning situations involving older rather than younger children.

This phenomenon has been found to hold for candy and abstract "score" reinforcers (Storm, Anthony, & Porsott 1965); praise, reproof, candy, and token reinforcers (Terrell & Kennedy 1957); and with promises and delayed reinforcers (Shipe & Lazarre 1969). Also, social reinforcement has been shown to be more susceptible to deprivation effects for older than younger children (Gewirtz & Baer 1958a).

It needs to be noted that in the above studies age is not being claimed as the only, or even the predominant, functional variable. It is merely held that significant age differences are an indicator of, among other possibilities, differing opportunities for the conditioning of reward stimuli.

It was posited that a reinforcing stimulus, regardless of its physical identity, may be used by the learner as a signal of response adequacy. The existence of such strategies was indicated by studies using multiple-choice selection tasks in which subjects informed only of their response successes (an information laden condition) performed significantly better than those informed only of their response errors (an information sparse condition) (Spence 1964a, 1966a). It was also posited that, perhaps partially via the conditioning of reward value to such stimuli as success and task completion, these strategies of information use and subsequent response modifi-

cation are learned.

If the use of information strategies is a learned skill, then because of the facilitative effect of such strategies on the use of feedback information, individuals who have had the opportunity to learn them should perform better on discrimination and selection tasks than individuals who have not. The availability of such learning opportunities will be at least partially and indirectly related to both time and environmental conditions. Thus, it would be expected that older individuals and those from comparatively enriched educational and problem-solving environments would perform better on such tasks than their younger and more environmentally deprived counterparts.

Many studies have yielded results supportive of the above expectations. Spence and her colleagues (Spence & Dunton 1967; Spence & Segner 1967) investigated R (reinforcement after a correct response, blank after an incorrect response), P (punishment after an incorrect response, blank after a correct response), and RP (reinforcement after a correct response, punishment after an incorrect response) combinations of verbal ("right" and "wrong") stimuli in a two choice discrimination task using four- to five- and eight-year-old subjects. Even though full prior instructions were given as to the meaning of both the stimuli and the blanks in each of the reinforcement combinations, it was found that the older subjects showed no differences in performance while the younger subjects per-

formed lower in the R group than in either of the other two conditions. This finding was shown to be due to the younger subjects having failed to correctly use the blank in the R condition as a signal of incorrectness.

Whitehurst (1969) found that five-year-olds showed little difference between performances on simple and complex discrimination tasks, whereas nine-year-olds, while superior overall to the younger subjects, performed significantly better on the simple than the complex task. This finding may indicate that the five-year-olds, compared to the older subjects, were relatively inefficient in utilizing the higher informational content inherent in the simple task reinforcement.

Spence (1966a), in a task using verbal ("right" and "wrong") reinforcers, found that adults drawn from the general population failed to use the information contained in the blanks under the R and P conditions, whereas college students used all the information available in each reinforcement condition.

In summary, older subjects more than younger subjects were able to use the response adequacy information contained in reinforcement. A similar distinction existed between individuals with differing spans of formal education. Thus, the results of these studies lent support to the position that strategies of attending to and using the informational content in reinforcers are learned.

The informational signal value of a reinforcing stimulus

is highly dependent upon the individual's awareness of the meaning of that stimulus in terms of response adequacy. Thus, full instructions explaining the significance of reinforcing stimuli to be used in a learning setting would be of some importance.

When no prior explanatory instructions have been given, it has been shown that the use of verbal ("right" and "wrong") reinforcers results in poorer performance under an R condition than under either P or RP conditions (Spence 1964b). This finding is usually interpreted as being due to the subjects having failed to react to the blank in the R condition as a signal of response incorrectness. However, when full prior instructions have been given, no differences between R, P, and RP conditions have been found (Spence & Segner 1967; Spence 1966b).

It has even been shown that in some cases prior instructions can equalize the informational value of signal stimuli which were originally not equivalent. Cairns (1967), and Spence, Armstrong, and Conrad (1969) compared the effects of verbal ("right" after a correct response) and nonverbal (buzzer sound after a correct response) signals with and without prior instructions. With prior instructions there were no significant differences between the performances of subjects under either reinforcement condition. However, without the prior instructions all subjects performed below the instructed groups, the nonverbal group showing little learning at all.

Thus, if an individual is to be given maximal opportunity to effectively modify his future responses in a learning task, it would appear that he needs to have been fully instructed as to the sources of all available response adequacy information.

In summary, studies have been cited which demonstrate that the effectiveness of both material and social reinforcers is dependent upon prior experiential history. Opportunity for simple interactions with a stimulus has been shown to be a variable in the conditioning of that stimulus as a reinforcer. Evidence has been presented in support of the existence of informational signal strategies, and also in support of the view that these strategies are learned.

The Influence of SES on Individual Differences

One premise in the present investigation was that there exist differences in the child-rearing environments of different levels of SES and that these differences effect the way the child reacts to reinforcing stimuli. In developing this position it is necessary to first determine the range and extent of these child-rearing differences, and second to determine their effect on child learning.

In studies comparing the child-rearing practices of upper and lower SES parents (e.g. Sears et al. 1957) the findings have consistently been that the upper SES (middle class) parent

is far more permissive in his relations with the child than is the lower SES parent. This finding has been shown to hold in each of the areas of oral behavior, toilet training, dependency, sex, aggressiveness, and freedom of movement (Bronfenbrenner 1958). As a consequence of this permissiveness the upper SES child is allowed more freedom of exploratory activity than his lower SES peer, both in terms of distance from the home and the range of stimulus objects with which he is permitted to interact (Sears et al. 1957).

Techniques of discipline differ between the different levels of SES. Bronfenbrenner (1958), for instance, noted that the upper SES parent, in contrast to the lower SES parent, makes greater use of symbolic as compared to material rewards.

It has been consistently noted that upper SES parents are more educated than their lower SES counterparts (Bronfenbrenner 1958; Kohn 1963; Sears et al. 1957). As a result of this difference a greater range of books and other symbolic materials would be expected to be available to the child in the upper SES home.

Kohn (1963) and Bronfenbrenner (1958) have shown that there are distinct differences in the values held by upper and lower SES parents. Lower SES parents want their children to conform to externally imposed standards, while upper SES parents are more interested in their children developing their own "internal" set of standards.

Kohn (1963) posits that if upper and lower SES parents consistently differ in their espoused values and child-rearing practices, then there must be some causal difference in their conditions of life. He sees the differences in upper and lower SES occupations as constituting the major basis of these conditions. While these differences may not constitute the single most dominant factor, it is at least plausible that parental values and child-rearing practices may partially result from parental occupation.

Kohn noted that upper SES occupations are concerned with interpersonal relations, ideas and symbols, and are likely to involve some measure of self-direction. Lower SES occupations are more concerned with the manipulation of things, and are usually subject to standardization and direct supervision. Over time it would be expected that the individual would be conditioned to espouse the values and skills, originally pertaining only to his occupational role, as having merit in their own right.

In the home, it is reasonable to expect that these learned values would be translated into child-rearing practices (Kohn 1963). It would be expected that the parent, whether upper or lower SES, would reinforce the child for exhibiting the valued behaviors (Staats & Staats 1963). Also, the parent, being a prestigious figure, would be expected to act as a model for the child (Bandura & Walters 1963).

Feshbach and Devor (1969) demonstrated such a modeling

effect in a study in which upper and lower SES four-year-old subjects taught a puzzle-solving task to three-year-old peers. Each teacher-subject exhibited reinforcement-punishment patterns characteristic of his SES.

In summary, there are definite differences in the physical, social, and intellectual environments of children from different SES levels. Upper SES parents are more permissive, accepting, and encouraging in relation to the child's interaction with the environment. Lower SES parents, in contrast, tend to emphasize the setting of restraints. Lower SES parents tend to develop behavioral conformity in their children, making predominant use of physical and material methods of reward and punishment. Upper SES parents are not so much interested in the child's actions as they are in his intent. They use predominantly abstract and symbolic methods of reward and punishment. It is plausible that parental occupation plays a causal role in the development of differing cognitive skills in the upper and lower levels of SES.

The basic difference believed to exist between children from upper and lower levels of SES is in the relative importance of the informational as compared to the reward factor involved in reinforcement. The upper SES child, as a result of his different rearing background, is presumed to have developed strategies of attending to and using the reinforcer predominantly as a source of response adequacy information. The lower SES child will not have developed these strategies to the same

level and for him the reward value of the reinforcer should be of greater importance.

Thus, in learning tasks, if full prior instructions have been given, it would be expected that the upper SES subject would show no significant difference in performance when reinforced by either a neutral response correctness signal or a stimulus that has conditioned reward value. The lower SES subject, while performing at an overall lower level than the upper SES subject, would be expected to perform significantly better under the reward than the signal condition.

However, a number of studies into SES versus reinforcement type have not shown this result. Typically, the findings have been that, as predicted, the lower SES children performed better under a reward condition, but that contrary to the prediction, the upper SES children performed significantly worse under the reward condition than under the signal condition (Spence & Dunton 1967; Spence & Segner 1967; Storm, Anthony, & Porsott 1965; Terrell, Durkin, & Wiesley 1959; Zigler & Kanzer 1962).

A possible reason for these seemingly contradictory findings is that under certain conditions of presentation, a physical reward stimulus may distract the attention of the learner away from the informational content. If, as is believed, upper SES children operate predominantly on informational signal strategies, then they would be especially susceptible to such distraction effects. Thus, if the distraction characteristics of the reinforcer are operative, a significant drop

in the performance of upper SES children under a reward condition would be expected.

A number of studies appear to support the distraction hypothesis. Candy (Penney & Lupton 1961; Fujitani 1969), money (Miller & Estes 1961), and promises of "candy later" (Terrell 1958) have all been shown to produce performances inferior to that under a signal condition.

Spence (1970) used upper and lower SES children in a discrimination task in which a correct response was reinforced under one of five conditions. These were: 1) a light flash defined as a signal of response correctness; 2) a bean token defined as a signal of response correctness; 3) a light flash defined in terms of "candy later" equivalence; 4) a bean token defined in terms of "candy later" equivalence; and 5) a candy. As would be expected if the distraction hypothesis were operative, the bean-reward and candy groups performed significantly poorer than the light-signal and bean-signal groups.

However, the upper SES light-reward subjects performed closer to the candy and bean-reward conditions than to the bean-signal and light-signal conditions. In contrast, the lower SES light-reward subjects were closer to the light-signal and bean-signal conditions. Thus, while the differences were not significant, it would appear that the upper SES light-reward subjects had suffered from a distraction effect while their lower SES counterparts had not. This finding is nevertheless explainable in that the light-reward would be distracting if

the subject tried to remember how many flashes had occured. Thus, individuals possessing greater symbolic skills, such as the upper SES children, would be susceptible to distraction. Persons with poorer symbolic skills, such as the lower SES children, would be able to effectively attend to the flash as only a signal stimulus, and would thus not be as susceptible to such distraction.

In summary, under conditions of presentation which tend to accentuate visual attractiveness, a physical reward stimulus may cause a decrease in performance as compared to a signal reinforcement condition. This phenomenon is assumed to be due to the learned reward value of such physical reinforcing stimuli distracting the attention of the learner away from the informational content of the reinforcer. Such an effect would rely upon the existence in the learner of informational strategies of response to a reinforcer. Therefore distraction should more likely occur for upper than for lower SES subjects since, as argued earlier, the former are expected to possess more sophisticated informational strategies than the latter.

As stated previously, if full prior instructions into reinforcement procedures are given, and if distraction effects are absent, then upper and lower SES children would be expected to react to reinforcing stimuli differently. The upper SES child should show little if any difference in performance under either a reward condition or a signal condition. Lower SES

children should perform better under a reward condition than a signal condition.

This expectation has been supported using candy and light flash reinforcers (Cameron & Storm 1965; Terrell & Kennedy 1957; Terrell 1958), and using "toy later" tokens and verbal ("right") reinforcers (Zigler & deLabry 1962). Thus support was gained for the proposition that for upper SES children there exists a more pronounced tendency to operate under an informational signal strategy than for lower SES children. Consequently, for lower SES children the reward value of a reinforcing stimulus is of greater relative importance than the response adequacy informational content.

From the preceding literature review it was noted that the research findings with respect to the relationship between SES and reinforcement, while generally supportive of the position that this relationship is functional, were not completely clear. No deliberate attempt had been made to separate the reward and information components of reinforcement. Too often the findings had been confounded by extraneous effects due to prior instructions and distraction from material reinforcing stimuli. Studies more often seemed to have been concerned with the type of stimuli that were effective as reinforcers with different SES subjects, rather than with determining the manner in which these reinforcers were utilized by the child.

It was the aim of this study, then, to separate to some

degree the reward and information components of reinforcement. In so doing some clarification of the manner in which children from different SES backgrounds react to reinforcers may have hopefully been provided. It was intended to explore the possibility that differences in performance between SES levels are due to differences in the facility with which the response adequacy information inherent in response contingent stimuli is utilized.

CHAPTER 3

Hypotheses and Rationale

As a basis for a criterion-directed response modification, it could be argued that reaction to a reinforcer as an information source is a more efficient and effective strategy than reaction to only the reward value possessed by that reinforcer. Thus upper SES subjects, who were posited to operate predominantly under such information strategies, were expected to show an overall higher level of performance than the lower SES subjects.

H_1: Upper SES subjects will attain criterion in the experimental task in fewer trials than will the lower SES subjects.

The second hypothesis was a direct consequence of the posited predominant reaction of lower SES subjects to the reward value of a reinforcing stimulus rather than to its informational content. If the reward component of a reinforcing stimulus is minimized, then a decrement in the performance of lower SES subjects would be expected.

H_2: Lower SES subjects will perform better under reward reinforcement conditions than under non-reward, information-only conditions.

It was possible that, because they were presumably accustomed to reacting to reinforcing stimuli as information signals, upper SES subjects may have been able to infer the informat-

ional relevancy of a non-reward, non-information, reinforcement condition. But since the reward value had been minimized, there was no potentially obvious link between the response-contingent stimulus and the response preceding it. Thus it was highly unlikely that such an inference would be made.

H_3: Under a condition in which both the reward and information components have been eliminated from the response-contingent stimuli, both upper and lower SES subjects will attain criterion in the experimental task in greater numbers of trials than under any of the other reinforcement conditions.

Upper SES subjects were expected to operate predominantly under an information signal strategy. Consequently, if no distraction effects were operative then no differences would be expected between any reinforcement condition that contained an information component. Under a reward-only condition in which the explicit informational component had been substantially reduced, a decrement in performance might have been expected. However, due to their typical reaction to the informational value of reinforcing stimuli, it seemed more probable that the upper SES subjects would infer the informational relevancy of a reward-only condition and thus such a decrement would be unlikely.

H_4: For upper SES subjects there will be no differences between the numbers of trials required to reach criterion on the experimental task under information-

only, reward-and-information, and reward-only reinforcement conditions.

Under an information-only condition in which the reward value of the reinforcing stimulus had been reduced, performance would be dependent upon the use of the response adequacy information contained in the reinforcer. Since such skills were expected to have developed to a higher level in the upper SES subjects, they were expected to perform better under such a reinforcement condition than their lower SES peers.

H_5: Under an information-only reinforcement condition in which the reward value has been substantially reduced, upper SES subjects will attain the experimental task criterion in fewer trials than will the lower SES subjects.

Since lower SES subjects were expected to react predominantly to the reward value of a reinforcing stimulus rather than its informational signal value, the presence or absence of an information component in a reinforcer should have made little or no difference to performance.

H_6: For lower SES subjects there will be no difference in the number of trials required to reach criterion on the experimental task under either reward-and-information or reward-only reinforcement conditions.

CHAPTER 4

Method

Subjects

The subjects used in the study were drawn from the 1970/71 Grade Two enrolment in selected schools in the Edmonton Public School system. A total of 128 children were used in the sample.

Initially, each child was given an explanatory letter and a permission blank to be taken home to his parents (see Appendix A). On the permission blank the parents were asked to provide the child's date of birth and the title or description of the present or last occupation of the main family supporter.

The sample was selected from those children whose parents returned permission blanks both granting approval and providing the required occupational information (the return rate on 400 blanks was approximately 75% and of these approximately 90% were favorable). Each of these usable returns was assigned a SES score using the Blishen (1968) occupational rank scale (see Appendix A). Each potential subject was then placed in a rank order utilizing his parent's occupational status for ranking. The upper and lower SES samples were then selected by taking the highest and lowest 64 subjects respectively from this ranked subject pool.

An IQ (Detroit Beginning First-Grade Intelligence Test

(Revised) 1935) for each of these selected subjects was extracted from their cumulative records. The testing date for these IQs was September 1969, these scores being the most current available.

The subjects were assigned to the eight experimental groups such that for both upper and lower SES samples separately, an equal distribution of SES and IQ scores existed. The means and standard deviations for SES, IQ, and chronological age (CA) of the eight experimental groups, the high and low SES samples, and the total sample are given in Table 1.

Tests on the significance of the differences between selected pairs of these means were made. Using two-tailed t tests for independent samples no significant differences were found between any of the four upper SES groups on each of SES, IQ, and CA. Similar results were found for the four lower SES groups (see Appendix B, Tables B1 to B6). In comparing the upper and lower SES samples both the SES (t_{obs} = 41.20, df = 126) and IQ (t_{obs} = 5.22, df = 126) differences were found to be significant beyond the .01 level. No significant difference in CA (t_{obs} = 1.47, df = 126) was found between the upper and lower SES samples.

Apparatus

The equipment used consisted of the following: remote control circular cassette slide projector; seven-by-ten inch rear-projection screen; remote control candy dispenser; push-

Table 1

Summary of SES, IQ, and CA data*

			SES	IQ	CA
Upper SES (Hi)	Candy Reinforcer (Ca)	Instructions (I)	73.89	111.5	7.84
			2.99	15.2	.26
		No Instructions (N)	70.64	113.4	7.85
			5.67	13.4	.31
	Light Reinforcer (Li)	Instructions (I)	72.14	111.5	7.90
			4.64	14.7	.32
		No Instructions (N)	71.89	110.1	7.78
			5.43	16.8	.34
	Total Upper SES Sample		72.14	111.6	7.84
			4.83	14.8	.31
Lower SES (Lo)	Candy Reinforcer (Ca)	Instructions (I)	34.48	98.4	7.90
			6.50	15.6	.41
		No Instructions (N)	31.95	98.1	7.83
			4.65	11.9	.31
	Light Reinforcer (Li)	Instructions (I)	31.53	97.9	8.05
			4.65	14.7	.42
		No Instructions (N)	34.72	98.3	7.94
			6.95	16.2	.39
	Total Lower SES Sample		33.17	98.2	7.93
			5.83	14.3	.38
Total Sample			52.65	104.9	7.89
			20.28	16.0	.35

* For each table entry, the upper figure is the mean and the lower figure is the standard deviation.

button signal light; two six-volt dry cell batteries; cassette tape recorder; two cassettes tapes; pair of response buttons; plastic cup with fitted lid; four-by-two foot black screening shield. The equipment was assembled during use in the form of a modified Wisconsin General Testing Apparatus (see Figures 1 and 2). The subject responded during the task by pressing the appropriate response button.

The stimulus materials were projections from color slides each showing a pair of geometrical shapes, a triangle and a circle, always of equal area. One shape was either red or blue, the other shape being the remaining color. The positions of the shapes, either right or left of each other, were varied. Thus there were four possible different stimulus pairs (red triangle - blue circle; red circle - blue triangle; blue triangle - red circle; blue circle - red triangle). Fifteen copies of each were used making a series of 60 stimulus pairs in total.

Design

The experimental task was a two choice visual discrimination problem. There were three dimensions of variation in the stimulus materials; shape, color, and position. For any one subject only one dimension was relevant (see Whitehurst 1969). Upon being presented with the stimulus pairs one at a time the subject was required to choose one from each pair by pressing the corresponding button. Depending upon the correctness of his choice the subject was then presented with feedback rein-

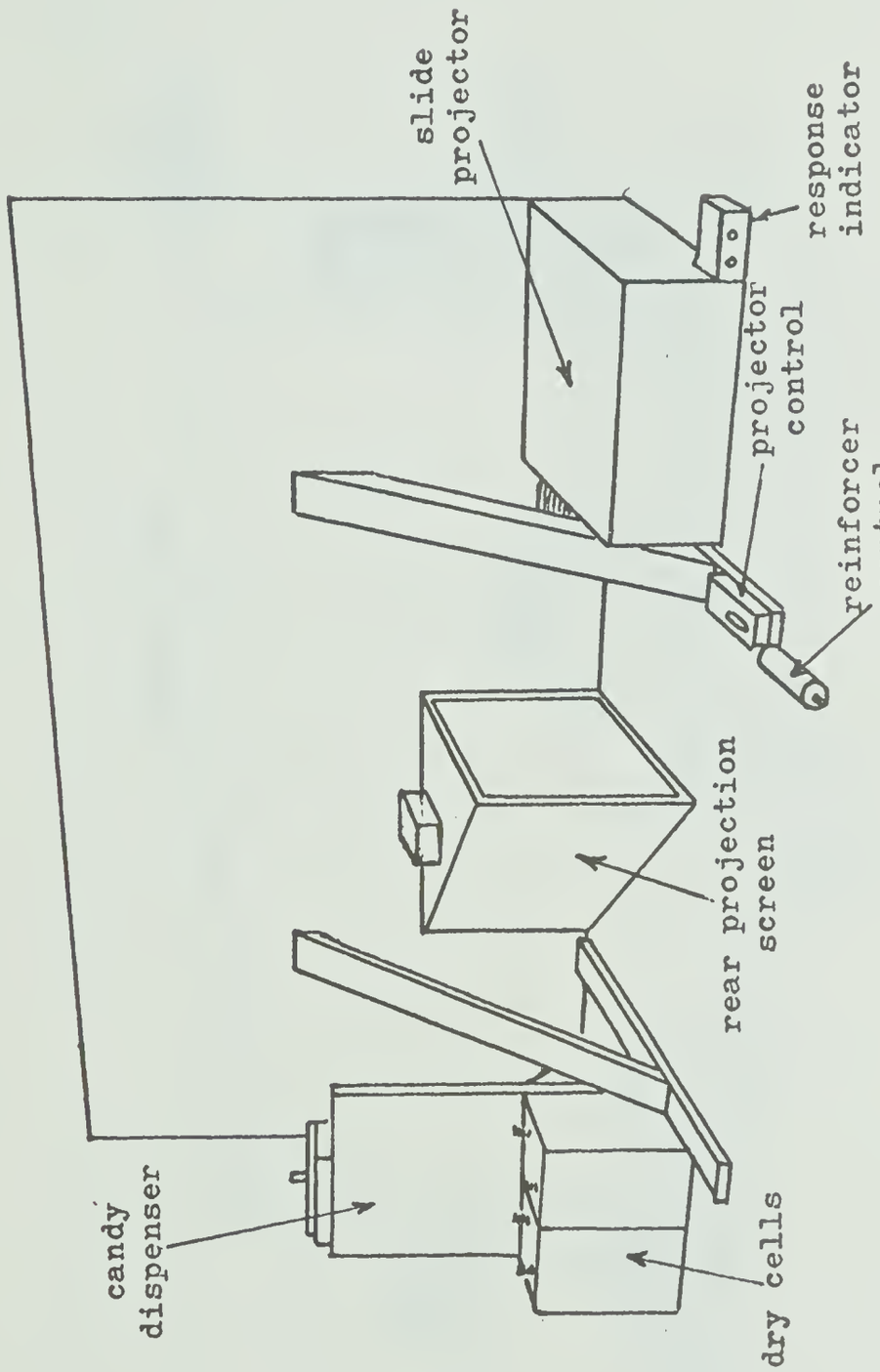

Fig. 1. Experimenter's view of apparatus.

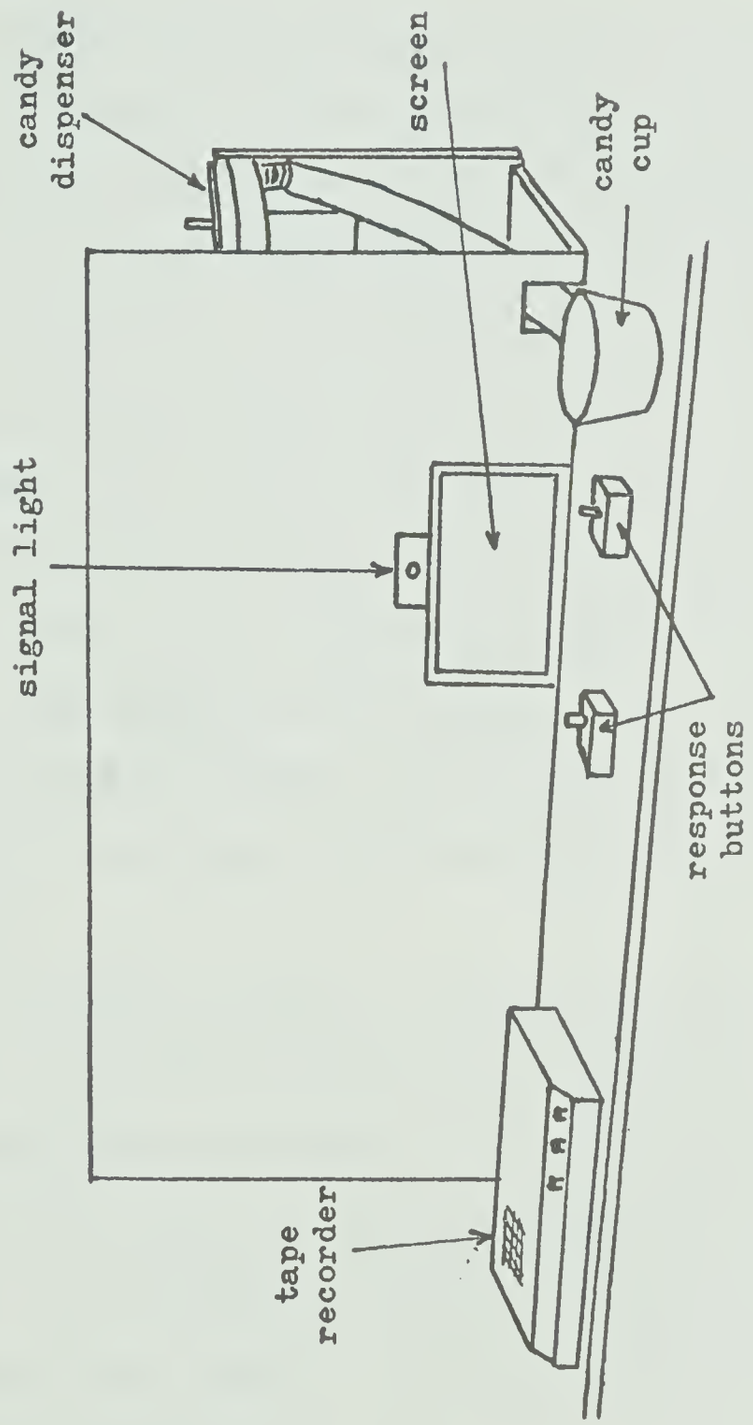

Fig. 2. Subject's view of apparatus.

forcement. The task for the subject was to eventually determine the relevant dimension and which cue within that dimension was correct (e.g. red within color, or triangle within shape).

The criterion for success in the task was ten consecutive correct responses. The major dependent variable was the number of trials required to reach this criterion (TTC).

The relevant dimension was counterbalanced between shape and color. Within each dimension the correct cue was also counterbalanced between either red and blue, or circle and triangle. The counterbalancing was evenly distributed across the experimental groups so that within each group of 16 subjects there were four subgroups containing four subjects each. The counterbalancing was arranged so that as far as possible each of these subgroups was equivalent in terms of SES and IQ. Position was always a variable within-trial irrelevant dimension.

The order in which the stimulus pairs were presented depended upon which task dimension (TD) had been designated as relevant. For each dimension the sequence was designed to minimize the chances of a subject attaining the criterion through the use of an incorrect response pattern (Gellermann 1933). Copies of the sequences used are given with the blank data sheets in Appendix A.

The 128 subjects in the total sample were divided into eight equal-sized experimental groups as seen in Table 1. Care

was taken to ensure that no group was drawn completely from one school. The statistical design of the study was a three-way factorial (SES x Reinforcement x Instructions) with two levels in each factor.

Within the SES factor, subjects were divided into upper (Hi) and lower (Lo) groups as described previously. The reinforcement factor consisted of the presentation of either a candy (Ca) or a light flash (Li). Within the instructions factor subjects were either completely informed (I) or told nothing (N) of the response-relevant nature of the reinforcing stimuli.

The light-instruction (LiI) groups represented an information-only reinforcement condition. A light flash was assumed to be an originally neutral stimulus. It would take on meaning particularly when the subject had been instructed as to the conditions of its presentation. Since it was not a material stimulus that would have had a reward conditioning history, its reward value would be expected to be low. However, since it was likely that some of the subjects would have had success conditioned as a reward stimulus, the absence of reward value in the LiI condition could not be assumed.

The candy-noninstruction (CaN) groups represented a reward-only reinforcement condition. Since the informational component of a reinforcer is dependent upon the subject being aware of its existence, the fact that these groups received no pretask instructions regarding the reinforcement procedures should have

substantially reduced the utility of the information contained in the reinforcer.

From similar arguments, the candy-instruction (CaI) groups represented a reward-and-information condition; and the light-noninstruction (LiN) groups represented a nonreward-noninformation condition.

Procedure

The subjects were tested individually in their respective schools. The average time required per subject was about 15 to 20 minutes.

Upon being brought to the experimental site (usually the school medical room or a conference room) the subject was seated in front of the small viewing screen (see Figure 2). The experimenter explained that the subject was about to play a little game in which some pictures would be projected onto the screen. The subject was then told to listen to a tape recording that would explain all the rules to the game.

The first part of the taped instructions was common to all groups. The subject was told that during the game he would be shown a series of pictures, two at a time. Each time he would be required to try to choose the picture that was correct. A dummy slide of similar format (green square - yellow diamond) to the actual task slides was then projected onto the screen. This was used to train the subject in the use of the response

buttons, and to give the subject practice in the type of responses involved in the task.

Subjects in the I conditions were then told that each time they chose the correct picture a piece of candy would fall into the cup in front of them (or for the LiI subjects that the light above the screen would flash on). They were also told that if they failed to get a candy (or light flash) it would mean that they chose the wrong picture and were losing the game. The presentation of the candy (or light flash) was demonstrated. For subjects in the Li condition the candy cup and tube were removed from in front of the shielding screen prior to the beginning of the session. In this way each subject saw only those articles with which he would be directly concerned.

Subjects in the CaN groups were not told of the candy's meaning in terms of response correctness, but merely had its presentation demonstrated. The purpose of this demonstration was to avoid the interrupting surprise reactions that would have occurred had no demonstration been given. LiN subjects were neither told of the meaning of the light flash nor did they have its presentation demonstrated.

In the final phase of the instructions, common to all groups, the subject was told that he need not hurry in making his choices since the next pair of pictures would not be presented until after he had pressed a response button. Finally, the subject was asked whether he had any questions. If he did, the experimenter answered them by repeating or rephrasing the

instructions given in the tape. Copies of the instructions given to each of the four reinforcement-instruction conditions are to be found in Appendix A.

Upon completion of the instructions the experimenter moved behind the shielding screen, out of the subject's view, and presented the first slide. As soon as the subject indicated his choice by pressing the button on the same side, the experimenter recorded the response, presented the relevant reinforcer if appropriate, and presented the next slide. This procedure was continued until the subject attained the criterion of ten consecutive correct trials, or until all 60 trials had been run.

There was no verbal communication between the subject and the experimenter during the trials. If the subject asked a question the experimenter answered as briefly as possible by repeating from the instructions tape. If subjects in the N conditions asked how they were to know whether they were winning the game the experimenter told them that it was part of the game to find out. Similarly, if subjects in the LiN condition asked what the flashing light meant they were told it was all part of the game to find out.

The cup into which the candies for the Ca groups fell was fitted during the trials with a lid. The subject was told that after the game he could have whatever candy was in the cup. Having seen the dispenser operate, the subject would have been well aware that he had received a candy when he did so, but since the cup was closed he would have had little inclination

to divert his attention from the stimulus materials to try to look at it. Also, since the container was directly in front of the subject, there was no possibility of his being cheated out of candies. Thus there would have been no need for him to try to remember how many candies he had earned. In this fashion it was hoped that the distraction effects reported by Spence and her colleagues would have been substantially reduced.

At the end of the trials, whether the subject had attained criterion or not, he was given any candies that he may have earned (if he was in the Ca conditions) as well as a candy bar of his choice. The subject was told that he had done very well in the game and that he had received the candy bar for being so good. He did not know before the game that he would receive the candy bar. The subject was then escorted back to his classroom after being asked not to tell any of the other children about the game.

CHAPTER 5

Results

All testing was carried out during April 1971. The data from individual subjects are tabulated by group in Appendix B in Tables B7 to B14. The major dependent variable was trials-to-criterion (TTC). However, since there were relatively large variances for each of the experimental groups on this variable, corroborative analyses were also performed on three other dependent variables: trial-of-last-error (TLE), total-number-of-errors (TNE), and a square root transformation (SRT) on TTC ($\sqrt{x} + \sqrt{x+1}$). Through the use of these extra dependent variables it was hoped that the influence of the large variances would be reduced. The means and standard deviations for each of the four dependent variables are given in Table 2 for each of the experimental groups, as well as for upper and lower SES samples, and the total sample.

Preliminary Analyses

As noted earlier, the task dimensions (TD) of color and shape were counterbalanced within each experimental group. Similarly, within each TD the relevant cue was also counterbalanced within each experimental group. Since no differences in performance on either TD or cue were expected, for verification a five way analysis of variance was run on SES, reinforcement, instructions, TD, and cue. For the purposes of the anal-

Table 2

Summary of TTC, TLE, TNE, and SRT data*

				TTC	TLE	TNE	SRT
		I	HiCaI	37.7	30.1	14.5	11.93
				19.2	22.3	10.5	3.36
	Ca						
		N	HiCaN	30.1	23.0	12.0	10.44
				21.8	25.9	14.5	3.83
Hi		I	HiLiI	42.3	36.9	19.0	12.64
				20.2	24.6	12.8	3.52
	Li						
		N	HiLiN	34.2	25.6	12.9	11.43
				17.1	19.4	9.8	2.97
	Total Hi Sample			36.1	28.9	14.6	11.61
				19.7	23.2	12.1	3.44
		I	LoCaI	36.8	30.6	14.7	11.66
				21.9	26.2	12.6	3.77
	Ca						
		N	LoCaN	40.7	34.6	14.8	12.33
				21.6	25.4	13.2	3.70
Lo		I	LoLiI	33.9	26.7	14.7	11.14
				21.9	25.5	13.9	3.82
	Li						
		N	LoLiN	50.5	46.2	23.7	14.12
				14.5	18.7	13.1	2.21
	Total Lo Sample			40.5	34.5	17.0	12.31
				20.7	24.7	13.5	3.55
Total Sample				38.3	31.7	15.8	11.96
				20.2	24.0	12.8	3.50

* For each table entry, the upper figure is the mean and the the lower figure is the standard deviation.

ysis, those subjects for whom either triangle or red were the relevant cues were pooled together as level one of the cue factor. Those for whom either circle or blue were the relevant cues were pooled together as level two. This simplification enabled the resulting analysis to be of the simple factorial type.

The results of this analysis on the dependent variable TTC are given in Table 3. As can be seen from the table, two four-way interactions involving cue were found to be significant beyond the .05 level. Also, one three-way interaction involving TD was found to be significant beyond the .05 level. These findings were replicated by the results of five-way analyses of variance using the dependent variables TLE and SRT, but only partially by those from an analysis using TNE (see Appendix B, Tables B15 to B17).

In interpreting the interactions involving cue it should be realized that in the five-way analyses the group sizes were four subjects each. Also, cue was the last factor over which the subjects from each experimental group were distributed in the initial formation of the sample. Consequently, compared to the other four factors in the analyses, the distributions with respect to cue of IQ, and any other unknown subject variables that may have been operative, were less likely to be uniform. Thus, since the two interactions were only two out of 16 possible effects involving cue, and since neither theory nor previous research findings gave any indications as to why

Table 3

Summary of Five-way Analysis of Variance

with Dependent Variable TTC

Source	df	MS	F	
A (SES)	1	612.50	1.73	
B (Reinf.)	1	480.50	1.36	
C (Instrn.)	1	47.53	.13	
D (TD)	1	157.53	.44	
E (Cue)	1	220.50	.62	
AxB	1	6.12	.02	
AxC	1	2610.03	7.36	P < .01
AxD	1	26.28	.07	
AxE	1	325.12	.92	
BxC	1	294.03	.83	
BxD	1	2.53	.01	
BxE	1	561.12	1.58	
CxD	1	544.50	1.54	
CxE	1	1188.28	3.35	
DxE	1	157.53	.44	
AxBxC	1	344.53	.97	
AxBxD	1	1667.53	4.71	P < .05
AxBxE	1	741.12	2.09	
AxCxD	1	36.12	.10	
AxCxE	1	331.53	.94	
AxDxE	1	1046.53	2.95	
BxCxD	1	392.00	1.11	
BxCxE	1	457.53	1.29	
BxDxE	1	1001.28	2.83	
CxDxE	1	364.50	1.03	
AxBxCxD	1	2.00	.01	
AxBxCxE	1	258.78	.73	
AxBxDxE	1	87.78	.25	
AxCxDxE	1	2244.50	6.33	P < .05
BxCxDxE	1	1830.12	5.16	P < .05
AxBxCxDxE	1	24.50	.07	
Error	96	354.39		

such significant cue effects would be expected in this study, it was concluded that these interactions involving cue were attributable to chance sampling effects and were therefore spurious.

Consequently, for further investigation of the significant interaction involving TD the data was pooled over cue and analyzed using a four-way analysis of variance on each of the dependent variables TTC (Table 4), TLE, TNE, and SRT (see Appendix B, Tables B18 to B20). The interaction between SES, reinforcement, and TD found to be significant under the five-way analyses remained so with the TTC and SRT four-way analyses, but not for those using TLE and TNE.

The form of the interaction involving TD was investigated with Newman-Keuls tests calculated using group TTC means pooled over the instructions factor, and separated on SES, reinforcement, and TD. None of the differences proved to be significant beyond the .05 level (see Table 5). This total lack of significant differences persisted even when a more microscopic inspection was made using Newman-Keuls tests on groups separated on each of SES, reinforcement, instructions, and TD.

Thus it would appear that while the SES x reinforcement x TD interaction was sufficiently pronounced to show as significant on the analyses of variance (for the TTC analysis $P \simeq .044$) it was nevertheless not pronounced enough to yield any significant differences between the appropriate group means. This finding, together with the fact that the interaction was not found to be

Table 4

Summary of Four-way Analysis of Variance

with Dependent Variable TTC

Source	df	MS	F	
A (SES)	1	612.50	1.53	
B (Reinf.)	1	480.50	1.20	
C (Instrn.)	1	47.53	.12	
D (TD)	1	157.53	.39	
AxB	1	6.12	.02	
AxC	1	2610.03	6.52	$P < .05$
AxD	1	26.28	.07	
BxC	1	294.03	.73	
BxD	1	2.53	.01	
CxD	1	544.50	1.36	
AxBxC	1	344.5312	.86	
AxBxD	1	1667.53	4.16	$P < .05$
AxCxD	1	36.12	.09	
BxCxD	1	392.00	.98	
AxBxCxD	1	2.00	.00	
Error	112	400.55		

Table 5

Summary of Newman-Keuls tests on group means pooled over the Instructions factor, and separated on TD, SES, and Reinforcement.

Table of between-group mean TTC differences.

	1 HiCa- color 28.93	2 LoCa- shape 35.68	3 HiLi- shape 36.37	4 LoLi- color 37.81	5 HiCa- shape 39.00	6 HiLi- color 40.18	7 LoCa- color 41.87	8 LoLi- shape 46.62
1	0	6.75	7.44	8.88	10.07	11.25	12.94	17.69
2		0	.69	2.13	3.32	4.50	6.19	10.94
3			0	1.44	2.63	3.81	5.50	10.25
4				0	1.19	2.37	4.06	8.81
5					0	1.18	2.87	7.62
6						0	1.69	6.44
7							0	4.75

r	2	3	4	5	6	7	8
crit diff (.05)	14.00	16.80	18.45	19.60	20.50	21.20	21.80
crit diff (.01)	18.50	21.00	22.50	23.51	24.35	25.05	25.60

significant for the TLE and TNE four-way analyses, was considered to be justifiable grounds for pooling the data over TD, and thus performing the major analyses of the study within an SES x Reinforcement x Instructions factorial design.

Major Analyses

The main analysis of the data used analysis of variance and analysis of covariance techniques, with a fixed effects model (Winer 1962). The preliminary assumption of homogeneity of variance was tested using the Hartley F_{max} statistic for equal group sizes. Calculated using the variances from the eight basic experimental groups, it was found that F_{max}(obs) was 2.27. The critical values for this statistic are 5.19 (at $P = .05$, $k = 8$, $df = 15$) and 7.10 (at $P = .01$, $k = 8$, $df = 15$). Thus it was concluded that the assumption of homogeneity was supported.

Analyses of the data were then conducted on the eight experimental groups separated on the factors of SES, reinforcement, and instructions as described earlier. The number of subjects in each group who reached the criterion of ten consecutive correct trials is graphed in Figure 3. Overall, more upper SES subjects (44) than lower SES subjects (34) attained the criterion. The LiI condition was the only one of the four in which the criterion was attained by more lower SES subjects (10) than upper SES subjects (8). The group means for each of the four dependent variables were given earlier in Table 2.

With data pooled over both cue and TD, a three-way analysis

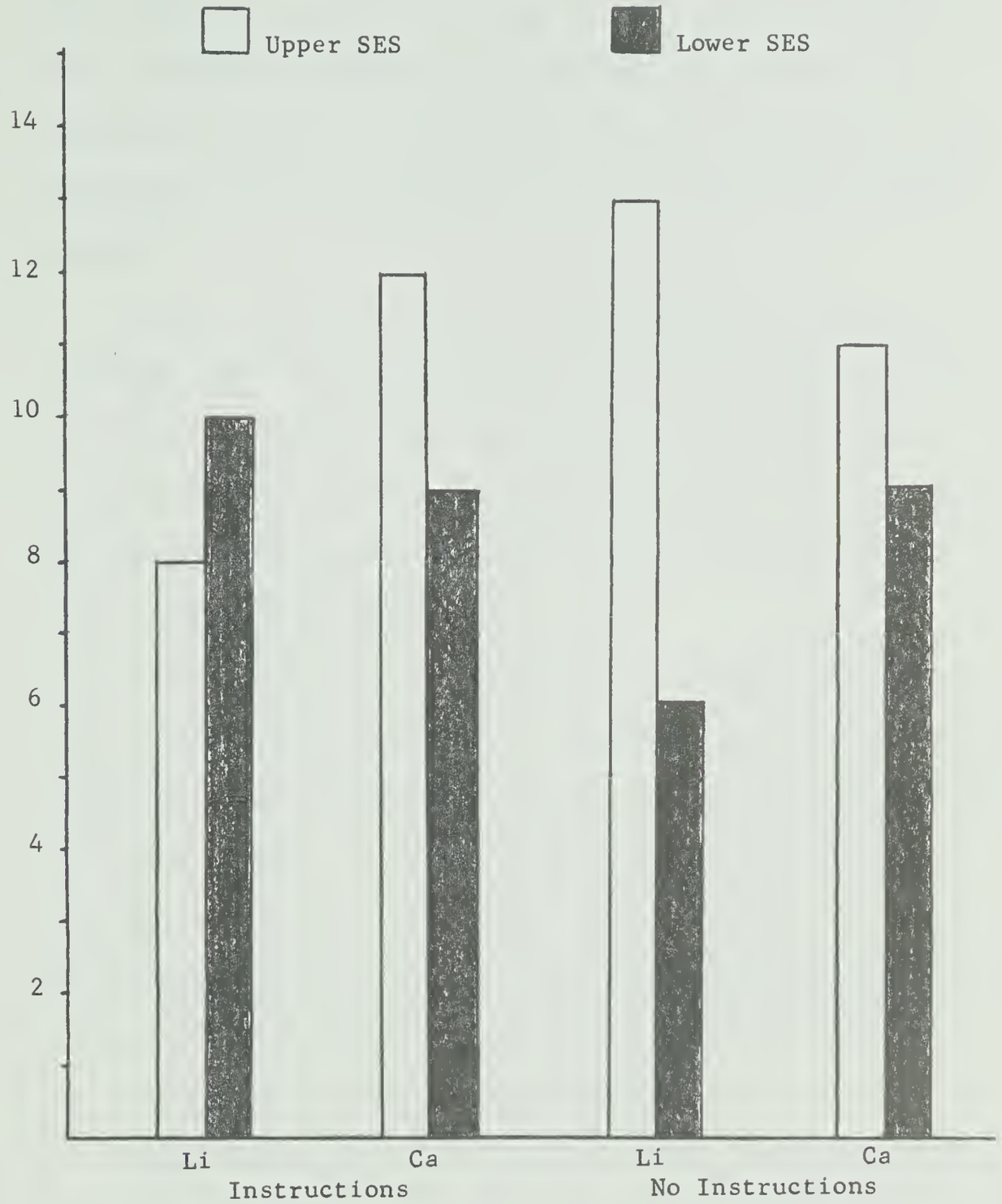

Fig. 3. Number in each group reaching criterion.

of variance was conducted on each of TTC (see Table 6), TLE, TNE, and SRT (see Appendix B, Tables B21 to B23). The only significant result in each of these analyses (beyond the .05 level for the TTC analysis) was the SES x instructions interaction.

As can be seen in Figure 4, upon preliminary inspection it would seem that the interaction was of a disordinal crossed form. For the instructions conditions the lower SES (Lo-I) subjects reached criterion in fewer trials than did their upper SES (Hi-I) counterparts, while the reverse was the case for the no-instructions conditions.

To investigate the structure of this interaction more closely Newman-Keuls tests were conducted using group TTC means pooled over the reinforcement factor. The results of these tests are given in Table 7. The only difference that proved to be significant (beyond the .05 level) was that between the upper SES no-instructions (Hi-N) and lower SES no-instructions (Lo-N) groups. The Lo-N subjects took significantly more trials to reach criterion than did the Hi-N subjects.

There was a possibility that the lack of significant findings above may have been in part due to a masking effect from the large TTC variances. Thus, since Newman-Keuls is a somewhat conservative test, less stringent t tests for independent samples were conducted on group TTC means. Also, the results of these tests were required for those hypotheses involving comparisons between specific groups. The mean TTC for LoLiN was found to

Table 6

Summary of Three-way Analysis of Variance

with Dependent Variable TTC

Source	df	MS	F	
A (SES)	1	612.50	1.54	
B (Reinf.)	1	480.50	1.21	
C (Instrn.)	1	47.53	.12	
AxB	1	6.12	.02	
AxC	1	2610.03	6.57	$P < .05$
BxC	1	294.03	.74	
AxBxC	1	344.53	.87	
Error	120	397.42		

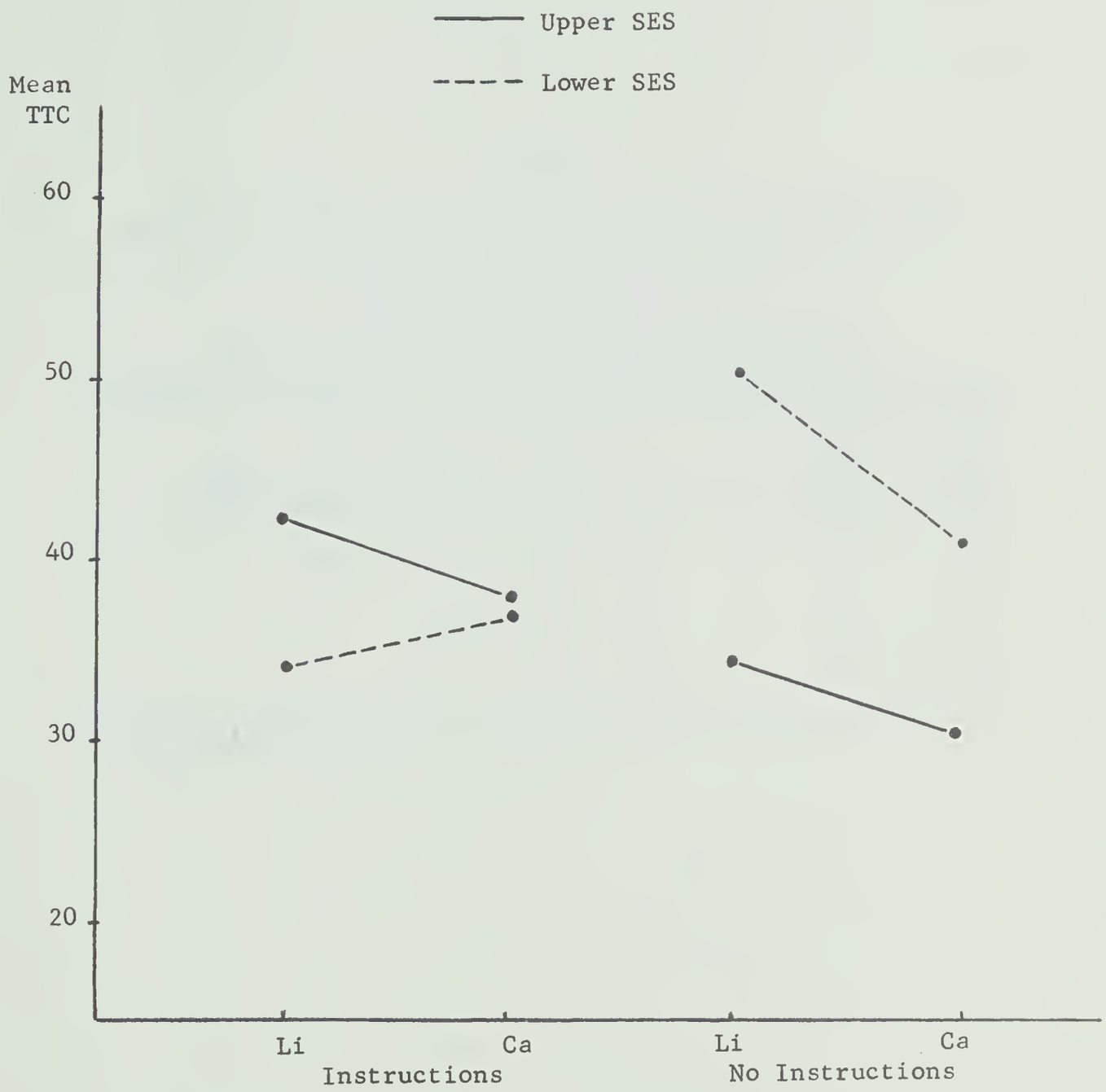

Fig. 4. Group TTC means.

Table 7

Summary of Newman-Keuls tests on group means pooled over the Reinforcement factor.

Table of between-group mean TTC differences.

	1 Hi-N 32.22	2 Lo-I 35.57	3 Hi-I 40.03	4 Lo-N 45.62	r	crit diff (.05)	crit diff (.01)
1	0	3.15	7.81	13.40*	4	12.99	15.84
2		0	4.66	10.25	3	11.83	14.78
3			0	5.59	2	9.86	13.02

* significant beyond the .05 level.

be significantly greater than that for each of LoLiI ($t_{obs} = 2.53$, $P < .01$), LoCaI ($t_{obs} = 2.09$, $P < .05$), HiLiN ($t_{obs} = 2.91$, $P < .01$), HiCaI ($t_{obs} = 2.12$, $P < .05$), and HiCaN ($t_{obs} = 3.11$, $P < .01$). None of the other mean TTC differences were significant beyond the .05 level.

These findings, together with the results of the earlier Newman-Keuls tests (see Table 7) seemed to indicate that a more proper interpretation of the SES x instructions interaction would be that it was ordinal. That is, that there were no differences among the Hi-I, Hi-N, and Lo-I groups, but that the Lo-N subjects took significantly more trials to reach criterion than did the other subjects.

The interaction between SES, reinforcement, and TD that had proved to be significant for some of the earlier four- and five-way analyses was interpreted as indicating the possibility that the different TDs may have in effect constituted two different tasks. Consequently, tentative three-way analyses of variance were performed separately on the 64 subjects who had had shape as the relevant TD and the 64 subjects who had had color as the relevant TD. Summaries of these analyses for TTC are presented in Tables 8 and 9 with their respective graphs of group means presented in Figures 5 and 6. Similar analyses were also conducted for the dependent variables TLE, TNE, and SRT.

None of the analyses showed any significant effects (beyond the .05 level); probably a result of the reduced sample sizes.

Table 8

Summary of Three-way Analysis of Variance

with Dependent Variable TTC

on the 64 subjects for whom the TD Shape was relevant.

Source	df	MS	F	
A (SES)	1	192.52	.46	
B (Reinf.)	1	276.39	.66	
C (Instrn.)	1	135.14	.32	
AxB	1	735.77	1.77	
AxC	1	1630.14	3.92	$P \simeq .053$
BxC	1	3.52	.01	
AxBxC	1	199.52	.48	
Error	56	416.05		

Table 9

Summary of Three-way Analysis of Variance

with Dependent Variable TTC

on the 64 subjects for whom the TD Color was relevant.

Source	df	MS	F
A (SES)	1	446.27	1.16
B (Reinf.)	1	206.64	.54
C (Instrn.)	1	456.89	1.19
AxB	1	937.89	2.44
AxC	1	1016.02	2.64
BxC	1	682.52	1.77
AxBxC	1	147.02	.38
Error	56	385.06	

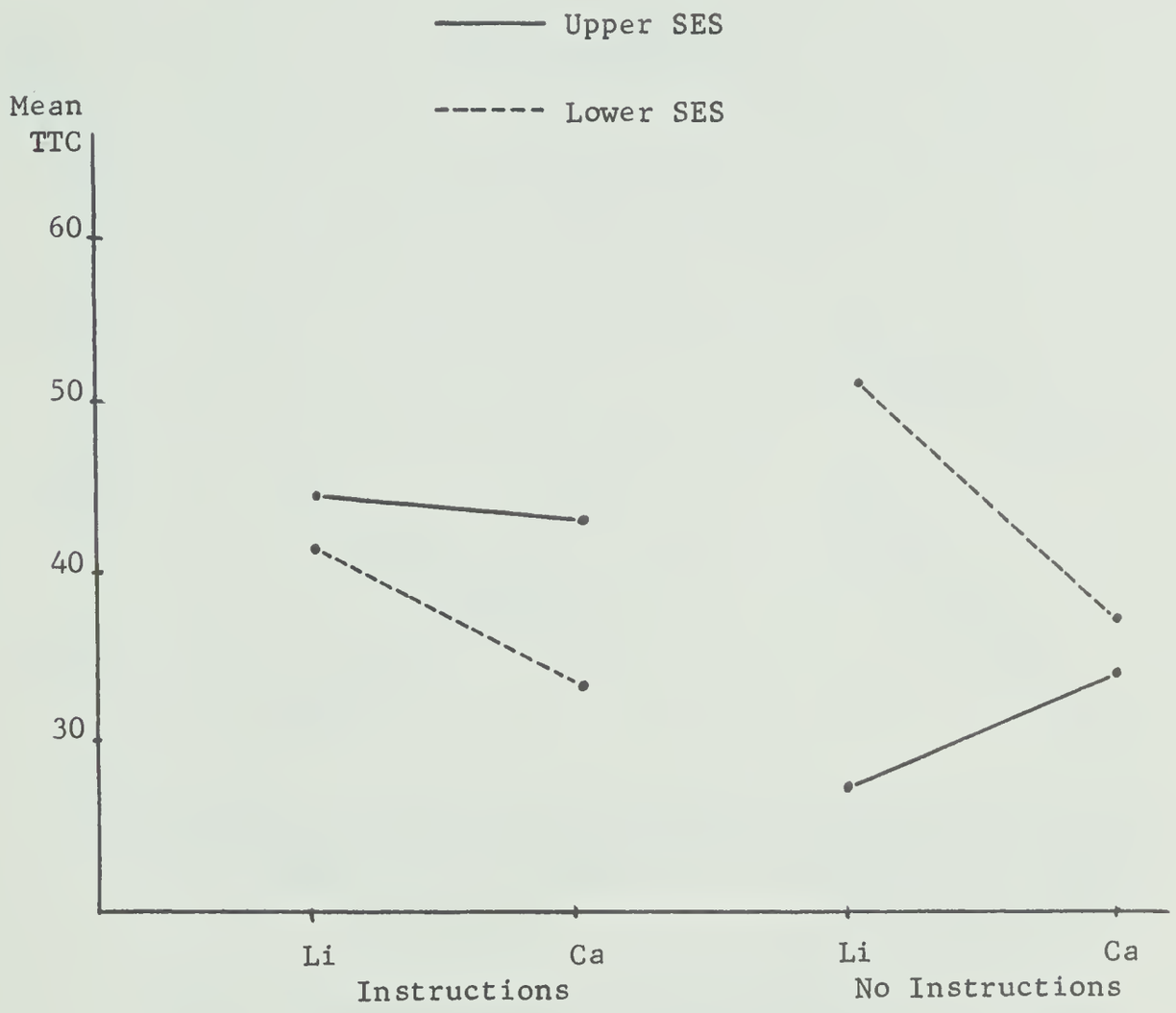

Fig. 5. Group TTC means for the 64 subjects for whom the TD of shape was relevant.

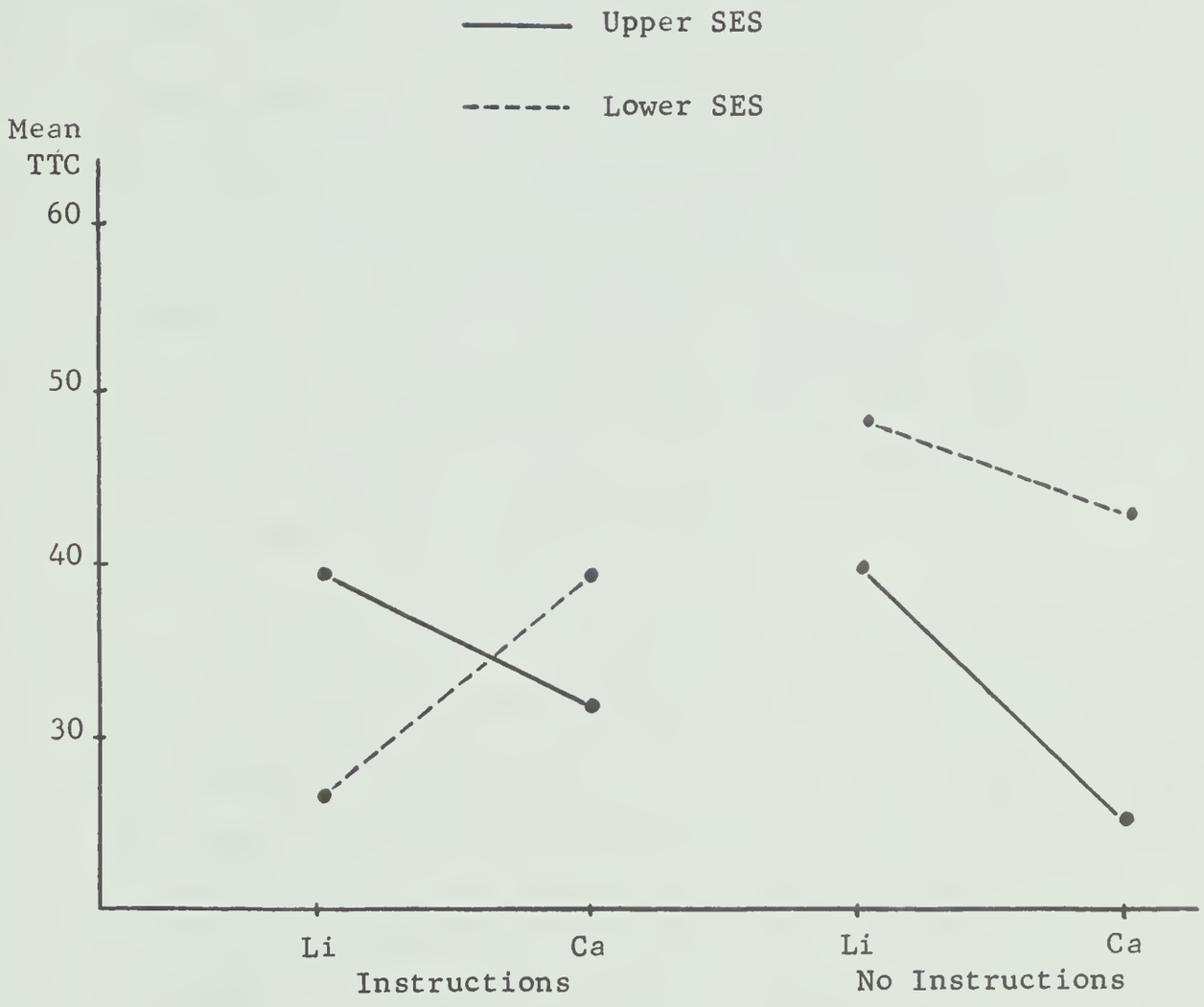

Fig. 6. Group TTC means for the 64 subjects for whom the TD of color was relevant.

However, it was interesting to note that the shape TD analyses for TTC, TLE, and SRT each showed SES x instructions interaction F ratios that approached significance (probabilities of .053, .059, and .054 respectively), whereas for the TD of color these same F ratios did not approach significance at all. But, Figures 5 and 6 showed the interaction as having the same basic form for both TDs. Thus, while the results of the above analyses may indicate underlying relationships requiring further study, it appeared that they held little import for the present investigation. That is, it was concluded that the two TDs constituted equivalent tasks.

As a preliminary to the analyses of covariance that follow, Pearson product-moment correlation coefficient matrices were calculated for each of the total sample (Table 10), the upper SES sample (Table 11), and the lower SES sample (Table 12), using the measures for SES, IQ, and CA, together with the dependent variables TTC, TLE, TNE, and SRT. The correlations between the four dependent variables were high, positive, and significant ($P < .01$) throughout. Correlations between CA and the dependent variables were small in magnitude and nonsignificant.

The CA versus SES correlation was negative and significant ($P < .05$) for the upper SES sample but nonsignificant for the other two samples. That is, for the upper SES sample the younger children tended to be higher on the SES scale than the older children. Since all subjects were from Grade Two it

Table 10

Correlations on measures with all 128 subjects

	SES	IQ	CA	TLE	TNE	SRT
TTC	-.11	-.19*	.05	.99**	.92**	.99**
SES		.44**	-.14	-.12	-.09	-.10
IQ			-.12	-.18*	-.16	-.20*
CA				.06	.05	.05
TLE					.93**	.98**
TNE						.91**

* significant beyond the .05 level.
** significant beyond the .01 level.

Table 11

Correlations on measures with the 64 Upper SES subjects.

	SES	IQ	CA	TLE	TNE	SRT
TTC	.04	-.25*	.01	.98**	.95**	.98**
SES		.15	-.27*	.02	.04	.05
IQ			.01	-.23	-.24	-.26*
CA				.02	-.01	-.00
TLE					.96**	.97**
TNE						.94**

* significant beyond the .05 level.
** significant beyond the .01 level.

Table 12

Correlations on measures with the 64 Lower SES subjects

	SES	IQ	CA	TLE	TNE	SRT
TTC	-.06	-.08	.06	.98**	.88**	.98**
SES		.18	.02	-.06	-.01	-.06
IQ			-.14	-.07	-.04	-.08
CA				.06	.08	.07
TLE					.90**	.97**
TNE						.88**

** significant beyond the .01 level.

seemed unlikely that enough time would have elapsed for this tendency to have been caused by differential rates of school progress. Thus, since the correlations for the lower SES sample and the total sample were nonsignificant, it would seem that no general underlying pattern was indicated. It was concluded that the one significant CA-SES correlation was spurious.

None of the correlations between SES and the dependent variables was significant. Since none of the analyses of variance indicated any significant SES main effects this result was to be expected.

For the total sample, significant ($P < .05$) correlations were found between IQ and each of TTC, TLE, and SRT. The TTC-IQ correlation was also significant for the upper SES sample ($P < .05$). These correlations were negative indicating that the higher IQ subjects tended to reach criterion faster than did the lower IQ subjects.

The SES-IQ correlation was significant ($P < .01$) and positive ($r \approx .44$) for the total sample, but nonsignificant for the upper and lower SES samples. Thus, over the total sample, the higher IQ subjects tended to be from the upper SES.

The significant correlations between TTC and IQ, and SES and IQ suggested the possibility that a sizeable proportion of the variances attributed by the analyses of variance to SES effects may in fact have been due to IQ differences; perhaps enough that the significant SES x instructions interact-

ion would disappear. Consequently, three-way analyses of covariance using IQ (see Table 13), CA (see Table 14), and IQ and CA combined (see Table 15 and Figure 7) as covariates were performed on TTC as well as each of TLE, TNE, and SRT (see Appendix B, Tables B24 to B32).

In each analysis of covariance the SES x instructions interaction remained significant at the .05 level or better. The mean square deviations for the SES main effects in the analyses using IQ or IQ-CA combined as covariates were the only mean square deviations to show any substantial change (e.g. 612 to 44 for TTC) from the corresponding analysis of variance values.

These findings indicated that a major proportion of the variance attributed by the analyses of variance to an SES main effect could have been equally attributed to IQ differences. Such a result was to be expected from the significant positive IQ-SES correlation. However, for each of the other effects, in particular the significant SES x instructions interaction, the variances were shown to be minimally related to IQ. From a comparison of Figures 4 and 7 it can be seen that apart from a general dampening effect the form of the lone significant interaction remained largely unaltered.

None of the mean square deviations in the CA covariate analyses were altered more than minimally from their corresponding analysis of variance values. Thus it was concluded that for the range of CAs represented by the sample, CA was functionally irrelevant.

Table 13

Summary of Three-way Analysis of Covariance

with Dependent Variable TTC

and Covariate IQ

Source	df	MS	F	
A (SES)	1	44.53	<1	
B (Reinf.)	1	430.89	1.11	
C (Instrn.)	1	50.07	<1	
AxB	1	2.15	<1	
AxC	1	2595.54	6.67	P<.05
BxC	1	266.06	<1	
AxBxC	1	393.18	1.01	
Error	119	389.03		

Table 14

Summary of Three-way Analysis of Covariance

with Dependent Variable TTC

and Covariate CA

Source	df	MS	F	
A (SES)	1	540.24	1.35	
B (Reinf.)	1	437.66	1.09	
C (Instrn.)	1	63.89	< 1	
AxB	1	12.16	< 1	
AxC	1	2635.61	6.59	P < .05
BxC	1	315.79	< 1	
AxBxC	1	331.72	< 1	
Error	119	399.81		

Table 15

Summary of Three-way Analysis of Covariance

with Dependent Variable TTC

and Covariates IQ and CA

Source	df	MS	F	
A (SES)	1	36.75	< 1	
B (Reinf.)	1	401.87	1.03	
C (Instrn.)	1	61.60	< 1	
AxB	1	4.90	< 1	
AxC	1	2613.50	6.67	P < .05
BxC	1	280.96	< 1	
AxBxC	1	382.37	< 1	
Error	118	391.83		

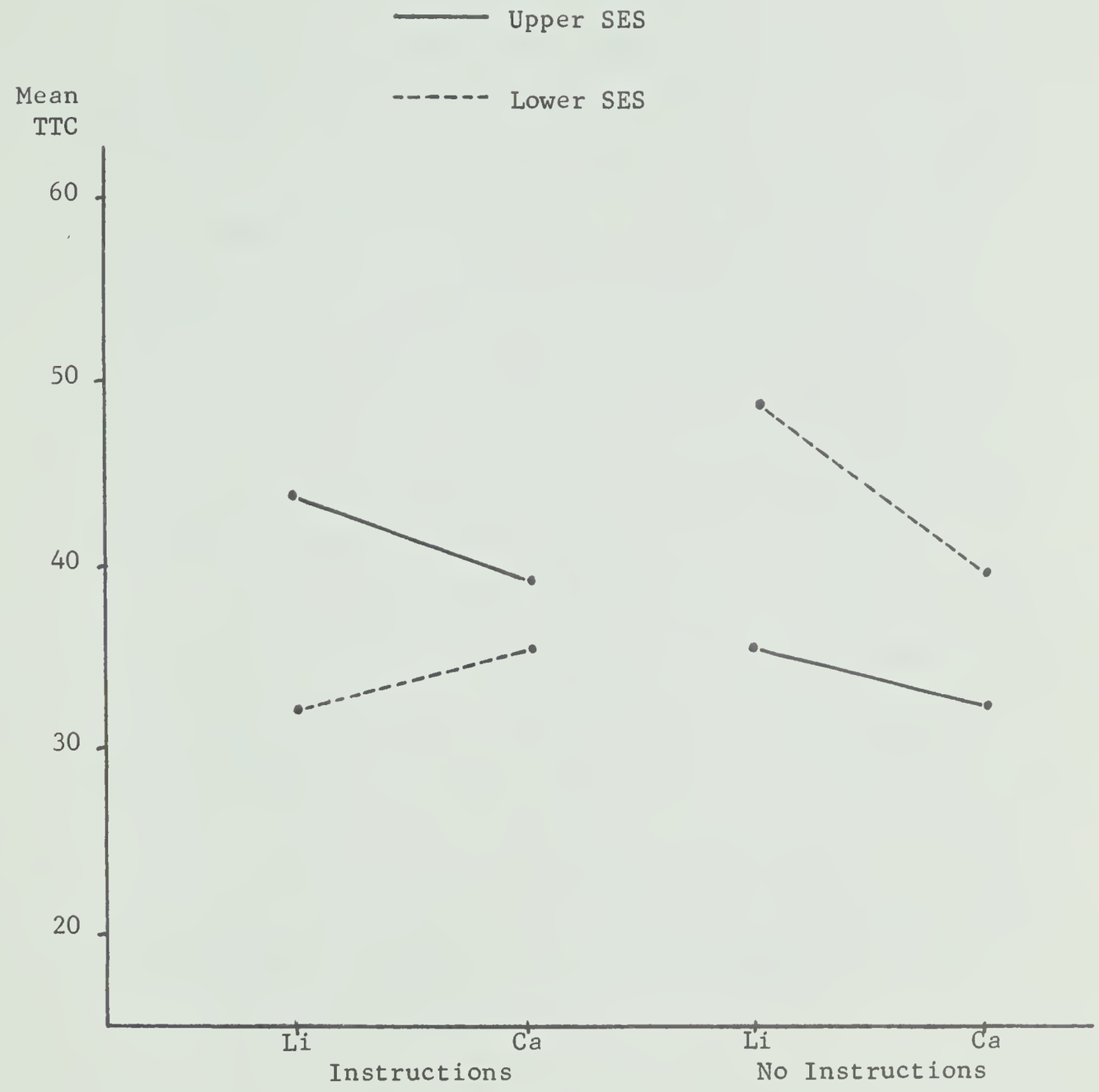

Fig. 7. Group TTC means for the Total Sample adjusted for IQ and CA as Covariates.

CHAPTER 6

Interpretation and Discussion

From the results of the t tests (see p.25) on group differences on the SES, IQ, and CA measures it was concluded that most of the sampling aims held for the initial formation of the experimental groups had been attained. It was thus assumed that 1) all experimental groups were equivalent in terms of CA, 2) each of the upper SES groups were equivalent in terms of SES and IQ, 3) each of the lower SES groups were equivalent in terms of SES and IQ, and 4) the upper and lower SES samples were different on the SES scale and thus did in fact constitute upper and lower SES samples. However, a lack of sufficient numbers in the original subject pool made effective matching impossible, and resulted in a significant IQ difference between the upper and lower SES samples. Such a relationship was not all that unexpected since it can be argued that IQ is at least partially a function of SES. Nevertheless, an analysis of covariance technique was employed to statistically control for this problem.

Discussion of the Hypotheses

Under hypothesis H_1, a significant SES main effect was expected. The differences between the upper and lower SES means on each of the four dependent variables used were in the predicted direction, indicating that the upper SES subjects tended to reach criterion on the task in fewer trials than did their lower SES

counterparts. However, from the analyses of variance and covariance it could be seen that none of these differences were significant beyond the .05 level. Consequently, H_1 was not supported.

Although significant SES main effects have not always been found (e.g. Terrell, Durkin, & Wiesley 1959; Zigler & Kanzer 1962), such a result is however the more frequent finding (e.g. Cameron & Storm 1965; Higgins & Archer 1968; Spence & Dunton 1967; Spence & Segner 1967). Thus the result of H_1 would appear to be at least partially contradictory to the results of previous studies.

A tentative explanation of this contradiction can be found in the fact that the majority of those studies showing significant SES effects were conducted in the U.S.A. Although the Blishen scale used in this study to determine SES is very similar to popular U.S. scales, it may be that occupations similarly placed by the Blishen and its U.S. counterparts in fact represent different living conditions.

Perhaps the lower SES occupations represent more extensive environmental deprivation conditions in the U.S.A. than in Edmonton, Canada, and vice versa for upper SES occupations. If such is the case then the population samples used in the U.S. studies will have represented a wider range in physical and social backgrounds than did the sample used in this study. One result of such sampling disparities would be that the likelihood of finding significant SES main effects in this study

would be lower than that for similar U.S. studies.

The possibility of different reference populations for U.S. and Canadian SES scales is discussed later in this chapter.

From hypothesis H_2, lower SES subjects under the candy reinforcement conditions were expected to perform better on the task than those under the information condition. This required that TTC for the LoLiI subjects be significantly greater than that for the LoCaI and LoCaN subjects. From the three-way analyses of variance and covariance it was seen that neither the reinforcement main effects nor any of the interactions involving reinforcement were significant beyond the .05 level. Also, t tests on the TTC means for the three groups concerned showed no significant differences. Thus, H_2 was not supported.

Upon inspection of the TTC group means it would appear that the tendency may in fact have been in the opposite direction to that predicted by H_2. The mean TTC for LoLiI was less than that for LoCaI which in turn was less than that for LoCaN. This tendency was also true for the TLE means. However, the magnitudes of these differences were small and nonsignificant, and effectively the same number of subjects reached criterion in each group (10, 9, 9). These findings, together with the fact that the mean TNE scores were not different (14.7, 14.7, 14.8), suggested that the proper interpretation of the results was that subjects from the LoLiI, LoCaI, and LoCaN

groups did not perform differently from each other.

This finding is somewhat contrary to other studies which have found that lower SES children perform better under candy than signal reinforcement conditions (Terrell, Durkin, & Wiesley 1959; Terrell & Kennedy 1957). In tentatively explaining this contradiction, it should be recalled that all subject testing was done during April. Thus all subjects would have had a minimum of nearly two complete years of school experience. Perhaps this was enough to cause the lower SES subjects in this study to use the reinforcers as information sources, thus reducing the hypothesized differences in reinforcer effectiveness.

Such an explanation was supported by the fact that the studies cited above used subjects (five- to six-years and four- to five-years respectively) younger than those used here. However, these studies also found a candy reinforcer to be more effective than a signal reinforcer with older lower SES subjects (ten- to eleven-years and eight- to nine-years respectively). Thus, while school experience may have had the suggested effect on the lower SES subjects in the present study, such an explanation does not adequately account for the contradiction of previous findings.

One possible explanation would be similar to that intimated in the discussion of H_1. If the range of SES sampled by this study was narrower than that sampled by the above U.S.

studies, then the subjects used in the latter may have come from environments intellectually less sophisticated than those of the subjects used here. This environmental difference may have produced a disparity between the abilities of the U.S. and Edmonton subjects to profit from schooling. The Edmonton lower SES children, if from comparatively more intellectually sophisticated backgrounds, may have benefited from their two years of schooling and thus have partially developed skills of attending to the informational content of reinforcers. In contrast, the children in the cited U.S. studies may not have so benefited, and thus may not have developed these informational skills to a similar extent.

Such a difference in informational skill development would predict the results of this study as well as those of the studies by Terrell and his colleagues. It would seem that the intellectual environments of the lower SES subjects in the Terrell studies were so unsophisticated that even the older subjects had not benefited from their extra schooling. Both age groups had apparently developed informational skills insufficient to enable them to attend equally to the candy and signal reinforcers.

Hypothesis H_3 was set up as a null hypothesis since only one other study had been found that contained such a condition (Cairns 1967). Specifically it predicted that TTC for HiLiN and LoLiN would not be significantly different, but that both

would be significantly greater than mean TTC for the other groups. The expectation however was that, if anything, the HiLiN group would perform better than the LoLiN group. This expectation found support from the results.

Thirteen of the HiLiN group reached criterion compared to only six for the LoLiN group. Although none of the variance and covariance analyses showed significant three-way interactions, they all showed significant SES x instructions interactions. From the t tests performed on group means it was found that the mean TTC for LoLiN was significantly greater than that for each of HiLiN, HiCaN, HiCaI, LoLiI, and LoCaI. Thus H_3 was rejected and the expectation, since the findings were not conclusive, was at least partially supported.

These findings lend support to the general proposition of this study that, compared to lower SES children, upper SES children should show a greater ability in the use of the informational content of response-contingent environmental stimuli. It would appear that this tendency was strong enough to have caused 13 out of the 16 HiLiN subjects to discover and then apply the relationship between the light flash and their response choices, all without any preliminary demonstration or instruction into the meaning or existence of this relationship. The effect was so marked, in fact, that the performance of the HiLiN group was not significantly different from that of any of the groups under the other reinforcement conditions.

In contrast to this, the LoLiN group showed a substant-

ially lower level of learning. Its performance was significantly poorer than all but two of the seven other experimental groups. If, as was tentatively suggested from the results for H_2, schooling tends to foster attention to the informational content of reinforcing stimuli, then the results presented here would seem to indicate that, at least during the early years of school attendance, this effect is either gradual or only partial. Even after nearly two years of schooling the lower SES subjects did not make use of the light flash's informational content unless they had received preliminary instructions as to its meaning. Perhaps the effect of this early schooling had been to facilitate the following of given rules and instructions rather than in developing skills for their independent deduction.

If it can be assumed that the school experiences for the HiLiN and LoLiN groups were substantially equivalent, and if the effect of that schooling was as suggested above, then it would seem that the ability of young children to independently determine patterns of reinforcement contingencies is related to experiential factors other than schooling. Since the groups were separated on SES, the above results would appear to support the proposition that the development of these information processing skills is at least partially a function of SES and its attendant differences in child-rearing practices.

Upper SES occupations tend to be more cognitive and self directive while lower SES occupations tend to be more subordinate and motor-manipulative. Therefore, if, as has been argued

earlier (Kohn 1963), parents tend to reinforce in their own children those skills that they themselves possess and value, then it would be expected that upper SES children would show a greater facility than lower SES children in the solution of cognitive tasks. The failure of the lower SES subjects in this study to maintain their level of performance when no preliminary instructions were given was interpreted as evidence of their less sophisticated level of development in these informational processing skills.

The significant SES x instructions interaction found in the analyses of variance was of course the result of the specific group differences reported above. From the results of the Newman-Keuls tests on group means pooled over reinforcement, together with those of the t tests on individual group means, this interaction was taken as being ordinal. That is, it was interpreted as indicating that there were no differences in performance between the Hi-I, Hi-N, and Lo-I subjects, but that the performance of the lower SES subjects suffered under the N condition. Since the implications to be drawn from this interaction are identical to those developed above, they need not be repeated here. However, a most interesting point to note about this interaction is that it remained significant in the analyses of covariance.

The use of IQ as a covariate, either independently or combined with CA, had minimal effect on the magnitude of the mean square deviations for the interaction. Consequently, even though

there was a significant positive correlation between IQ and SES it would appear that the manner in which the different SES subjects reacted to the preliminary instructions or lack thereof was independent of IQ.

The Detroit Beginning test used in this study to obtain the subjects' IQ ratings consists largely of visual labeling and discrimination tasks. For instance, the subjects would be asked to mark the biggest of three circles, the error in a drawing of a dog with two tails, or the two things that were most alike in a series of pictures. From the results above it would seem that these tested skills are minimally related to the informational processing skills sampled in this study. Perhaps both types of skills are partially but independently a function of SES. Such a position is theoretically more tenable than trying to invoke IQ as an explanatory construct for SES differences. As Skinner (1969) noted, such constructs are only of intermediate value since all behavior must eventually be explained by an analysis of the phylogenic and ontogenic contingencies that gave rise to it.

The data gave support to hypothesis H_4 under which no performance differences among the HiLiI, HiCaI, and HiCaN groups were expected. None of the three-way interactions in any of the analyses of variance or covariance was significant beyond the .05 level. The results of the t tests indicated that none of the differences among TTC means for the three

groups was significant.

Thus, from these results support was found for the proposition that upper SES children tend to react to a reinforcer independently of its actual physical identity. Such a tendency would have the effect of lessening any performance differences that might otherwise be expected to arise from the use of different types of reinforcing stimuli.

As has been argued earlier, the intellectual environment of the upper SES child is more sophisticated than that of the lower SES child. Upper SES parents, more than lower SES parents, are likely to model information processing skills for their children. Also, upper SES parents would be expected to reinforce their children for exhibiting similar information processing behavior.

The likely effect of such implicit behavioral shaping is that the upper SES child will develop skills of attending to the informational content of response-contingent stimuli, irrespective of their actual physical identities. Concomitant to the development of such skills will be the conditioning of such abstract stimuli as success, and possibly even the presence of an information source, to attain positive reward value. However, since it will be to the informational content of a reinforcing stimulus that the upper SES child will primarily attend, no performance differences would be expected for conditions differing in the type of reinforcing stimulus used.

An inspection of the group means themselves showed that

the two I condition groups took more trials to reach criterion than did the N condition group. This was the opposite of what the effect of preliminary instructions would be expected to be (e.g. Spence 1966b). The provision of preliminary instructions regarding the meaning of the reinforcing stimuli seems to have had a detrimental effect. Perhaps the presentation of a reinforcer to the Hi-I condition subjects served to prompt them to recall their preliminary instructions, thus reducing the efficiency with which they could attend to the reinforcer's informational content. Such an effect could possibly have been caused by the preliminary instructions being too long or too detailed. The subjects might have been overburdened with things to remember.

The possibility of such interference at a cognitive level is an interesting topic that could be developed through further research. However, in the present study, because of the lack of consistent group differences, and because none of the other studies reviewed (with the possible exception of the distraction effects reported by Spence 1970) have shown any similar interference effects with instructions, the interpretation taken of the data was that the three groups concerned did not perform differently from each other.

Under hypothesis H_5, the mean TTC for HiLiI was expected to be less than that for LoLiI. The results of t tests showed that the group means for these two groups were not significantly different beyond the .05 level. Thus the data

did not support the hypothesis.

A possible explanation for the lack of the predicted difference is that put forward in the discussion of H_2 and H_3. The nearly two years of schooling that each subject would have had may have influenced the lower SES subjects to attend to the informational content of the light flash, particularly since they had received preliminary instructions as to its meaning.

When the group means were inspected it was seen that the HiLiI group actually took more trials to reach the criterion than did the LoLiI group; the reverse of what was expected. Bearing in mind that this difference was not significant and thus not likely to be indicative of any real effect, an explanation similar to that presented in the discussion of H_4 can nevertheless be tentatively offered here. The upper SES subjects may have experienced interference from trying to keep the preliminary instructions continually in mind. As discussed earlier, the results of H_3 can be interpreted as indicating a generally lower level of sophistication in symbolic skills for the lower SES subjects compared to their upper SES counterparts. If this interpretation is correct, then the lower SES subjects in the LoLiI group should not have been as susceptible to such instructions interference and thus would not have experienced the subsequent detriment in performance.

The prediction from hypothesis H_6 was that minimal differences in performance would occur between the LoCaI and LoCaN

groups. Under the t tests the group TTC means for these two groups were not found to be significantly (beyond the .05 level) different, thus supporting the hypothesis. Also, the same number in each group attained the criterion. However, since H_2 failed to find support, the support given here to H_6 cannot strictly be interpreted as indicating that for the lower SES subjects the presence or absence of an information component in the reinforcer made little or no difference to performance. In fact, the results for this hypothesis now yield little additional information to that already deduced from the previous results.

Further Points of Interest

There are two further points of interest that arise from the data analysis. The first of these has been suggested, though implicitly, in the earlier discussion. The significant SES x reinforcement interaction found in other studies reviewed (Cameron & Storm 1965; Storm, Anthony, & Porsott 1965; Terrell, Durkin, & Wiesley 1959) was not found in this study. As mentioned previously, it was suggested that this may have been due to the influence of schooling with the lower SES subjects and a possible instructions interference effect with the upper SES subjects.

The second point of interest is a procedural one. In the initial design of the experimental procedure it was decided

to have the candies in the Ca conditions fall into a closed cup. The idea behind this was that if the subject could not see the candies then he would not be as susceptible to the distraction effects found in some other studies (Spence 1970; Spence & Dunton 1967; Spence & Segner 1967). If a distraction effect had been operative it would be expected that the Ca condition subjects would have taken more trials to reach criterion than those in the Li conditions, especially for the upper SES subjects. The reinforcement main effects in the analyses of variance and covariance were nonsignificant. Also, although none of the group means were significantly different the upper SES Ca subjects did tend to reach criterion in fewer trials than did the upper SES Li subjects. Thus, it was concluded that distraction effects had been successfully eliminated.

Concluding Discussion

Some interesting points arise out of the earlier discussion surrounding H_1. If, as was suggested, the range of SES sampled in this study was narrower than that sampled by the reviewed U.S. studies, then the difference in living conditions between upper and lower SES subjects in Edmonton would not have been as great as that for the U.S. upper and lower SES subjects. Such a possibility would indicate that instead of being contradictory, the lack of expected significant differences for H_1, H_2, and H_5 may have actually been proper reflections of the

populations sampled. It should be noted, however, that while perhaps not as extensive and broad as those sampled in the U.S.A., the Edmonton SES differences sampled in this study were nevertheless real and sufficiently pronounced to produce a significant SES x instructions interaction.

If the range of SES is wider in the U.S.A. than in Canada, then the possibility arises that U.S. studies in this area may be sampling predominantly from the extremes of the SES continuum. That is, the research results may be at least partially inappropriate for the middle bulk of the population. While not wishing to detract from the importance of such research, surely the question of practicality would indicate the need to extend research into the centre of the SES scale.

On the whole, the question of international differences in SES range offers some interesting opportunities for future research. Among other possibilities, samples drawn from SES extremes in several countries could be compared via their performances on a variety of tasks.

The possibility of cognitive interference resulting from preliminary instructions, as suggested in the discussion of H_4, also presents some interesting research questions. Several groups of subjects could be given the same task but preceded by instructions of differing complexity. It would also be interesting to investigate the relationship between this instructions interference effect and age (as an index of schooling). Also, the interaction with SES could perhaps be further inves-

tigated using a multi-level, three factorial (SES x instructional complexity x age) design.

While the results of this study were generally supportive of the position that children of different SES will differ in their level of sophistication with symbolic skills, they were not conclusive. A more sensitive means of detecting these differences seems to be needed. One possibility would be the ability to profit from instruction.

Rapier (1968) used such a design with serial and paired-associate learning tasks to show that lower SES mental retardates benefited more than upper SES mental retardates from an intervening teaching sequence. She interpreted the results as indicating that, compared to the upper SES, for the lower SES retardation may be more a product of cultural rather than organic deprivation.

Perhaps a similar relationship may exist for normal children on a visual-discrimination problem-solving task such as that used in the present study. If lower SES children are lacking in symbolic sophistication then they should show a greater improvement following a problem-solving teaching sequence than upper SES children.

As a result of the overall inconclusiveness of the results, there was really only one implication for education that could be drawn from this study with any degree of security. From the analysis results and the significant SES x instructions

interaction it would seem that more emphasis could profitably be placed on the teaching of symbolic skills. Such emphasis, particularly for lower SES children in the first two years of schooling, could be concentrated on the independent solution of symbolic problems. The aim of such teaching would be the fostering of independent symbolic skills.

Using simple problem-solving tasks, solution strategies could be initially modeled for the student by either the teacher or suitable peers. Once the student had learned the rudiments of such strategies he could be encouraged to tackle problem-solving tasks by himself. These tasks could be gradually increased in complexity until the student could eventually tackle problem-solving tasks independently of any help or prior prompting from others.

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APPENDIX A

Department of Educational Psychology

University of Alberta

Edmonton, Alberta

February 15, 1971

MESSAGE TO PARENTS:

The Educational Psychology Department of the University of Alberta has attracted to the University a large group of staff and graduate students who are interested in research in child learning. During the last school year, various research workers from the University have engaged in research with children in the Edmonton Public and Separate Schools, and in schools of surrounding communities.

This spring we are interested in exploring various problems in learning in young children. Your co-operation in permitting your child to participate in this Educational Research Project will be appreciated.

The period will be approximately 30 minutes during school hours. The study will be conducted at the school. The child will be accompanied by a trained research worker at all times.

The results of this study will, of course, merely provide statistical information for a research project investigating the nature of learning by children. They will NOT be used in any way in connection with your child's work in school, and will be confidential.

We are deeply concerned with a possible relationship between skills and techniques developed by the parents in their occupational roles and those developed by the parents in their children. The results of this project will aid us in the design of methods of teaching that take into account the various types of skills currently possessed by the child.

Please complete the attached Permission Form, and have your child return it to the classroom teacher. We would appreciate receiving an answer even if you do not wish your child to participate, since we wish to be certain that all parents have, in fact, received this request.

Yours sincerely,

Gerard M. Kysela, PhD.,
Assistant Professor,
Department of Educational
Psychology

PERMISSION FORM

Name of child:_____

Date of birth: Month_____ Day_____ Year_____

School:_____ Grade:_____

Please check one of the following:

I hereby give my permission for my child to participate in this project, part of the Educational Research being conducted by the University of Alberta. _____

I would rather not have my child participate in this experiment. _____

Exact title or description of present or last occupation of family supporter:

_____

_____

Parent's or Guardian's signature:_____

Date:_____

Socioeconomic Status of Occupations in Canada

(Blishen 1968, pp. 745-750)

Occupation	Socio-economic index	Occupation	Socio-economic index
Chemical engineers	76.69	Owners and managers, paper and allied industries	64.78
Dentists	76.44	Owners and managers, finance, insurance, real estate	64.52
Professors and college principals	76.01	Authors, editors, journalists	64.23
Physicians and surgeons	75.57	Owners and managers, rubber industries	64.09
Geologists	75.49	Owners and managers, machinery industries	63.76
Mining engineers	75.42	Librarians	63.75
Lawyers and notaries	75.41	Owners and managers, petroleum and coal products industries	63.02
Civil engineers	75.16	Sales managers	62.04
Architects	74.52	Owners and managers, mines, quarries, and oil wells	61.99
Veterinarians	74.46	Owners and managers, textile industries	61.96
Electrical engineers	74.34	Owners and managers, transportation equipment industries	61.75
Professional engineers, n.e.s.	74.27	Professional occupations, n.e.s.	60.93
Physicists	73.81	Credit managers	60.81
Optometrists	73.77	Office managers	60.42
Biological scientists	73.22	Owners and managers, health and welfare services	60.07
Physical scientists, n.e.s.	72.94	Security salesmen and brokers	59.91
Pharmacists	72.87	Radio and television announcers	59.81
Mechanical engineers	72.78	Owners and managers, printing, publishing, and allied industries	59.69
Judges and magistrates	72.24	Owners and managers, federal administration	59.60
Economists	71.89	Owners and managers, knitting mills	59.28
Chemists	70.94	Clergymen and priests	59.20
Industrial engineers	70.43	Owners and managers, miscellaneous manufacturing industries	58.29
Osteopaths and chiropractors	70.25	Other health professionals	58.27
School teachers	70.14	Artists (except commercial), art teachers	58.21
Accountants and auditors	68.80	Inspectors and foremen, communication	58.17
Owners and managers, education and related services	68.32		
Actuaries and statisticians	67.78		
Computer programmers	67.50		
Owners and managers, services to business management	67.28		
Agricultural professionals, n.e.s.	66.96		
Owners and managers, chemical and chemical products industries	66.79		
Advertising managers	66.05		
Air pilots, navigators, and flight engineers	66.04		
Owners and managers, electrical products industries	65.78		
Owners and managers, primary metal industries	65.29		

Occupation	Socio-economic index
Draughtsmen	57.82
Owners and managers, metal fabricating industries	57.60
Owners and managers, leather industries	57.23
Social welfare workers	55.62
Owners and managers, non-metallic mineral products industries	55.41
Advertising salesmen and agents	55.37
Purchasing agents and buyers	55.22
Insurance salesmen and agents	55.19
Owners and managers, clothing industries	54.77
Science and engineering technicians, n.e.s.	54.75
Brokers, agents, and appraisers	54.74
Owners and managers, provincial administration	54.54
Artists, commercial	54.06
Owners and managers, transportation, communication, and other utilities	53.85
Owners and managers, wholesale trade	53.80
Owners and managers, local administration	53.29
Surveyors	53.25
Commercial travellers	52.68
Owners and managers, furniture and fixtures industries	52.11
Teachers and instructors, n.e.s.	52.07
Stenographers	51.96
Owners and managers, food and beverage industries	51.70
Radio and television equipment operators	51.51
Physical and occupational therapists	51.11
Athletes and sports officials	51.11
Musicians and music teachers	50.93
Nurses-in-training	49.91
Bookkeepers and cashiers	49.55
Funeral directors and embalmers	49.47
Foremen, transportation equipment industries	49.21
Foremen, primary metals industries	49.11
Real estate salesmen and agents	48.74
Medical and dental technicians	48.58
Photo-engravers	48.28
Photographers	48.07
Engravers (except photo-engravers)	47.95
Ticket, station, and express agents, transport	47.61
Batch and continuous still operators	47.60
Office appliance operators	47.12
Owners and managers, construction industries	46.95
Foremen — electric power, gas, and water utilities	46.75
Power-station operators	46.20
Locomotive engineers	45.99
Conductors, railroad	45.68
Owners and managers, wood industries	45.52
Owners and managers, miscellaneous services	45.48
Foremen, paper and allied industries	45.36
Owners and managers, motion picture and recreational services	45.19
Linemen and servicemen — telephone, telegraph, and power	45.05
Foremen, other manufacturing industries	45.01
Lithographic and photo-offset occupations	45.00
Toolmakers, diemakers	44.82
Inspectors, construction	44.76
Interior decorators and window-dressers	44.37
Foremen, trade	44.32
Foremen — mine, quarry, petroleum well	44.27
Telephone operators	44.20
Owners and managers, forestry, logging	44.00

Occupation	Socio-economic index
Actors, entertainers, and showmen	43.85
Owners and managers, retail trade	43.69
Mechanics and repairmen, office machines	43.05
Clerical occupations, n.e.s.	42.98
Mechanics and repairmen, aircraft	42.76
Nurses, graduate	42.57
Compositors and typesetters	42.30
Deck officers, ship	42.13
Religious workers	41.84
Members of armed forces*	41.43
Locomotive firemen	40.92
Electricians, wiremen, and electrical repairmen	40.68
Auctioneers	40.48
Canvassers and other door-to-door salesmen	40.23
Brakemen, railroad	40.22
Paper-makers	40.17
Owners and managers, personal services	40.14
Printing workers, n.e.s.	40.13
Mechanics and repairmen, radio and TV receivers	40.12
Photographic progressing occupations	40.05
Engineering officers, ship	39.86
Millwrights	39.83
Inspectors, graders, and samplers, n.e.s.	39.82
Inspectors, examiners, gaugers — metal	39.76
Pattern-makers (except paper)	39.75
Typists and clerk typists	39.66
Postmasters	39.65
Well-drillers and related workers	39.55
Foremen, all other industries	39.54
Pressmen, printing	39.49
Telegraph operators	39.37
Inspectors and foremen, transport	39.21
Projectionists, motion picture	39.15
Foremen, textile and clothing industries	39.03
Lens grinders and polishers; opticians	38.82
Bookbinders	38.54
Foremen, food and beverage industries	38.21
General foremen, construction	37.90
Operators, electric street railway	37.80
Stationary enginemen	37.79
Rolling-mill operators	37.76
Chemical and related process workers	37.75
Prospectors	37.73
Foremen, wood and furniture industries	37.63
Sales clerks	37.14
Machinists and machine-tool setters	36.90
Jewellers and watchmakers	36.55
Civilian protective service occupations†	35.80
Stewards	35.32
Farm managers and foremen	35.05
Other occupations in bookbinding	34.97
Baggagemen and expressmen, transport	34.85
Metal-treating occupations, n.e.s.	34.79
Mechanics and repairmen, n.e.s.	34.77
Riggers and cable splicers, except telephone and telegraph and power	34.77
Furnacemen and heaters — metal	34.75
Cellulose-pulp preparers	34.69
Stock clerks and storekeepers	34.63
Logging foremen	34.61
Beverage processors	34.44

* Includes commissioned officers, armed forces; and other ranks, armed forces.

† Includes firemen, fire protection; policemen and detectives; and guards, watchmen, n.e.s.

Occupation	Socio-economic index
Plumbers and pipefitters	34.38
Heat-treaters, annealers, temperers	34.09
Paper-making occupations, n.e.s.	34.07
Hoistmen, cranemen, derrickmen	34.06
Inspectors, graders, scalers – log and lumber	33.80
Electrical and electronics workers, n.e.s.	33.80
Switchmen and signalmen	33.76
Fitters and assemblers – electrical and electronics equipment	33.57
Sheet-metal workers	33.49
Metal drawers and extruders	33.40
Miners	33.38
Bartenders	33.29
Insulation appliers	33.22
Roasters, cookers, and other heat-treaters, chemical	33.14
Furriers	33.03
Boiler-makers, platers, and structural metal workers	32.93
Welders and flame cutters	32.79
Timbermen	32.61
Tire- and tube-builders	32.34
Filers, grinders, sharpeners	32.18
Service workers, n.e.s.	32.17
Nursing assistants and aides	32.14
Shipping and receiving clerks	32.14
Millmen	32.13
Bus drivers	31.86
Forest rangers and cruisers	31.85
Metalworking-machine operators	31.67
Quarriers and related workers	31.61
Moulders	31.32
Porters, baggage and pullman	31.30
Mechanics and repairmen, motor vehicle	31.30
Mechanics and repairmen, railroad equipment	31.29
Fitters and assemblers – metal	31.28
Crushers, millers, calenderers – chemical	31.12
Electroplaters, dip platers, and related workers	31.07
Cutters, markers – textiles; garment and glove leather	31.06
Production process and related workers, n.e.s.	31.00
Lodging and boarding housekeepers	30.94
Barbers, hairdressers, and manicurists	30.94
Cabinet- and furniture-makers, wood	30.88
Driver–salesmen	30.74
Labourers, primary metal industries	30.68
Metalworking occupations, n.e.s.	30.60
Deck ratings (ship), barge crews and boatmen	30.56
Paper products makers	30.53
Postmen and mail carriers	30.52
Service-station attendants	30.48
Butchers and meat-cutters	30.48
Meat-canners, curers, packers	30.48
Motormen (vehicle), except railway	30.48
Waiters	30.47
Hawkers and peddlars	30.43
Oilers and greasers – machinery and vehicles (except ship)	30.43
Tobacco preparers and products makers	30.39
Upholsterers	30.27
Tailors	30.26
Labourers, trade	30.19
Bleachers and dyers – textiles	30.18
Painters (construction and maintenance), paperhangers, and glaziers	30.08
Taxi drivers and chauffeurs	30.07
Operators of earth-moving and other construction machinery	30.03
Painters (except construction and maintenance)	30.00
Coremakers	30.00
Baby sitters	29.99
Labourers, mine	29.96

Occupation	Socio-economic index
Blacksmiths, hammermen, forgemen	29.93
Bricklayers, stonemasons, tile-setters	29.93
Attendants, recreation and amusement	29.92
Plasterers and lathers	29.90
Other food-processing occupations	29.89
Bottlers, wrappers, labellers	29.80
Clay, glass, and stone workers, n.e.s.	29.77
Materials-handling equipment operators	29.76
Labourers, paper and allied industries	29.73
Carpenters	29.71
Vulcanizers	29.62
Fruit- and vegetable-canners and packers	29.60
Other rubber workers	29.51
Labourers, communication and storage	29.51
Milk processors	29.49
Cooks	29.43
Construction workers, n.e.s.	29.43
Longshoremen and stevedores	29.41
Truck drivers	29.31
Gardeners (except farm) and groundskeepers	29.27
Bakers	29.26
Labourers, electric power, gas, and water utilities	29.26
Messengers	29.23
Warehousemen and freight-handlers	29.18
Polishers and buffers — metal	29.12
Boiler firemen (except ship)	29.10
Labourers, all other industries	28.96
Launderers and dry cleaners	28.93
Other agricultural occupations	28.93
Dressmakers and seamstresses	28.77
Riveters and rivet-heaters	28.76
Millers of flour and grain	28.75
Furnacemen and kilnmen, ceramics and glass	28.69
Knitters	28.68
Transport occupations, n.e.s.	28.63
Labourers, other public administration and defence	28.61
Woodworking occupations, n.e.s.	28.56
Stone-cutters and dressers	28.52
Apparel and related products makers	28.44
Tanners and tannery operatives	28.42
Sawyers	28.29
Woodworking-machine operators	28.29
Labourers, other manufacturing industries	28.22
Janitors and cleaners, building	28.22
Labourers, food and beverage industries	28.12
Kitchen helpers and related service workers	28.11
Engine-room ratings, firemen and oilers, ship	28.11
Newsvendors	28.08
Labourers, railway transport	28.03
Finishers and calenderers	27.97
Elevator-tenders, building	27.96
Shoemakers and repairers, not in factory	27.87
Sewers and sewing-machine operators	27.87
Cement- and concrete-finishers	27.86
Guides	27.79
Farm labourers	27.77
Labourers, transportation (except railway)	27.72
Labourers, wood industries	27.57
Labourers, transportation equipment industries	27.49
Other textile occupations	27.44
Carders, combers, and other fibre-preparers	27.37
Labourers, construction	27.25
Other leather products makers	27.19
Fishermen	27.17
Leather-cutters	27.10
Loom-fixers and loom-preparers	27.09
Lumbermen, including labourers in logging	27.01

Occupation	Socio-economic index	Occupation	Socio-economic index
Spinners and twisters	26.94	Labourers, textile and clothing industries	26.56
Weavers	26.77	Shoemakers and repairers — in factory	26.56
Teamsters	26.71	Fish-canners, curers, and packers	26.09
Labourers, local administration	26.71	Trappers and hunters	25.36
Winders and reelers	26.63		
Sectionmen and trackmen	26.57		

DATA SHEET

Experimental Group:_____ Name:_____

Birthday:_____ Date Tested:_____

CA:_____ IQ(Cum. Card):_____

Relevant Dimension: SHAPE Positive Cue: Triangle ( )
Circle ( )

Trials to Criterion:_____ (▨ denotes red)

1	R W			14	R W		
2	R W			15	R W		
3	R W			16	R W		
4	R W			17	R W		
5	R W			18	R W		
6	R W			19	R W		
7	R W			20	R W		
8	R W			21	R W		
9	R W			22	R W		
10	R W			23	R W		
11	R W			24	R W		
12	R W			25	R W		
13	R W			26	R W		

27	R W			44	R W		
28	R W			45	R W		
29	R W			46	R W		
30	R W			47	R W		
31	R W			48	R W		
32	R W			49	R W		
33	R W			50	R W		
34	R W			51	R W		
35	R W			52	R W		
36	R W			53	R W		
37	R W			54	R W		
38	R W			55	R W		
39	R W			56	R W		
40	R W			57	R W		
41	R W			58	R W		
42	R W			59	R W		
43	R W			60	R W		

DATA SHEET

Experimental Group:_____ Name:_____

Birthday:_____ Date Tested:_____

CA:_____ IQ(Cum. Card):_____

Relevant Dimension: COLOR Positive Cue: Red ( )
Blue ( )

Trials to Criterion:_____ (▨ denotes red)

1	R W			14	R W		
2	R W			15	R W		
3	R W			16	R W		
4	R W			17	R W		
5	R W			18	R W		
6	R W			19	R W		
7	R W			20	R W		
8	R W			21	R W		
9	R W			22	R W		
10	R W			23	R W		
11	R W			24	R W		
12	R W			25	R W		
13	R W			26	R W		

27	R W			44	R W		
28	R W			45	R W		
29	R W			46	R W		
30	R W			47	R W		
31	R W			48	R W		
32	R W			49	R W		
33	R W			50	R W		
34	R W			51	R W		
35	R W			52	R W		
36	R W			53	R W		
37	R W			54	R W		
38	R W			55	R W		
39	R W			56	R W		
40	R W			57	R W		
41	R W			58	R W		
42	R W			59	R W		
43	R W			60	R W		

Script of Recorded Instructions

Preliminary Instructions given to all Subjects

Hello!

Today you are going to play a little game, during which some pictures will be shined onto the screen in front of you. Each time there will be two pictures, one of which will always be correct. Now, what you have to do to win the game is to choose, each time, the one you think is correct.

On the table in front of you, you will see two buttons. In the game you will use these buttons to tell which pictures you think are correct.

Before you start the game, let's try these buttons so that you will know how they work. Here are some pictures.

(Experimenter projects a dummy slide onto screen)

Choose the square by pressing the button on the same side.

(Experimenter informs subject of his correctness)

Press the button that chooses the green.

(Experimenter informs subject of his correctness)

Suppose you thought the diamond was correct, press the button that would show it.

(Experimenter informs subject of his correctness)

Pick the yellow by pressing the button on the same side as it is.

(Experimenter informs subject of his correctness)

Remember, in the game always show the picture you think

is correct by pressing the button that is on the same side as the picture.

Further Instructions for the CaI Subjects

Now you know how to work the buttons properly. However, before you start the game there is one more thing you should know.

In front of you, on the table, you will see a little closed cup. The plastic tube that comes out of the top goes to a candy machine. Everytime you choose the correct picture a piece of candy will come down the tube into the cup. This will mean that you are winning the game. If you don't get a candy, then it will mean that you chose the wrong picture, and that you are losing the game.

Watch and see how it works.

(Experimenter operates the candy dispenser to allow a piece to fall into the cup which is open for the demonstration)

Don't touch the cup now, but after the game you can have all the candy that is in it.

Okay, I think you are ready to start the game. Remember, if you get a candy then it means that you were correct and that you are winning the game. If you don't get a candy then it means that you were wrong, and that you are losing the game.

As each two pictures shine on the screen, look at them carefully and decide which of the two you think is correct. When you have picked one, press the button that is on the

same side. Don't worry about trying to go too fast. The next two pictures will not come on until after you have pressed the button.

Do you have any questions?

(Experimenter answers any questions by a repetition of the relevant instructions)

Okay, let's start. Here are the first two pictures.

(Experimenter begins projecting the task slides)

Further Instructions for the LiI Subjects

Now you know how to work the buttons properly. However, before you start the game there is one more thing you should know.

In front of you, at the top of the screen, you will see a light. Each time you choose the correct picture this light will flash on. This will mean that you are winning the game. If the light doesn't flash on, it means that you chose the wrong picture, and that you are losing the game.

Watch and see how it works.

(Experimenter operates the light)

Okay, I think you are ready to start the game. Remember, if the light flashes on then it means that you were correct and are winning; if the light does not flash on then it means that you were wrong and are losing.

As each two pictures shine on the screen, look at them carefully and decide which of the two you think is correct.

When you have picked one, press the button that is on the same side. Don't worry about trying to go too fast. The next two pictures will not come on until after you have pressed the button.

Do you have any questions?

(Experimenter answers any questions by repetition of the relevant instructions)

Okay, let's start. Here are the first two pictures.

(Experimenter begins projecting the task slides)

Further Instructions for the CaN Subjects

Now you know how to work the buttons properly. However, before you start the game there is one more thing you should know.

In front of you, on the table, you will see a little closed cup. The plastic tube that comes out of the side goes to a candy machine.

Watch and see how it works.

(Experimenter operates the candy dispenser to allow a piece of candy to fall into the cup which is open for the demonstration)

Don't touch the cup now, but after the game you can have whatever candy is in it.

Okay, I think you are ready to start the game.

As each two pictures shine on the screen, look at them carefully and decide which of the two you think is correct. When you have picked one, press the button that is on the same

side. Don't worry about trying to go too fast. The next two pictures will not come on until after you have pressed the button.

Do you have any questions?

(Experimenter answers any questions by repetition of the relevant instructions. If Subject asks how he is to know whether he is correct, Experimenter tells him that it is all part of the game.)

Okay, let's start. Here are the first two pictures.

(Experimenter begins projecting the slides for the task)

Further Instructions for the LiN Subjects

Now you know how to work the buttons properly. I think you are ready to start the game.

As each two pictures shine on the screen, look at them carefully and decide which of the two you think is correct. When you have picked one, press the button that is on the same side. Don't worry about trying to go too fast. The next two pictures will not come on until after you have pressed the button.

Do you have any questions?

(Experimenter answers any questions by repetition of the relevant instructions. If Subject asks how he is to know whether he is correct, Experimenter tells him that it is all part of the game.)

Okay, let's start. Here are the first two pictures.

(Experimenter begins projecting the task slides)

APPENDIX B

Table B1

Summary of t tests on between-group mean SES differences for the 64 Upper SES subjects. Table of t values.

	HiLiN	HiCaI	HiCaN
HiLiI	.14	1.27	.82
HiLiN		1.29	.64
HiCaI			2.03

Critical t for a two-tailed test at the .05 level with 30 df is $t(.025) = 2.04$.

Table B2

Summary of t tests on between-group mean SES differences for the 64 Lower SES subjects. Table of t values.

	LoLiN	LoCaI	LoCaN
LoLiI	1.53	1.47	.27
LoLiN		.11	1.32
LoCaI			1.26

Critical t for a two-tailed test at the .05 level with 30 df is $t(.025) = 2.04$.

Table B3

Summary of t tests on between-group mean IQ differences for the 64 Upper SES subjects. Table of t values.

	HiLiI	HiCaN	HiCaI
HiLiN	.25	.61	.24
HiLiI		.38	0
HiCaN			.37

Critical t for a two-tailed test at the .05 level with 30 df is $t(.025) = 2.04$.

Table B4

Summary of t tests on between-group mean IQ differences for the 64 Lower SES subjects. Table of t values.

	LoLiI	LoCaN	LoCaI
LoLiN	.07	.04	.02
LoLiI		.04	.09
LoCaN			.06

Critical t for a two-tailed test at the .05 level with 30 df is $t(.025) = 2.04$.

Table B5

Summary of t tests on between-group mean CA differences for the 64 Upper SES subjects. Table of t values.

	HiLiN	HiCaI	HiCaN
HiLiI	1.03	.58	.45
HiLiN		.56	.64
HiCaI			.10

Critical t for a two-tailed test at the .05 level with 30 df is $t(.025) = 2.04$.

Table B6

Summary of t tests on between-group mean CA differences for the 64 Lower SES subjects. Table of t values.

	LoLiN	LoCaI	LoCaN
LoLiI	.79	1.02	1.68
LoLiN		.29	.88
LoCaI			.58

Critical t for a two-tailed test at the .05 level with 30 df is $t(.025) = 2.04$.

Table B7

Subject Data for LoCaN Group

Task dimension = shape

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	38.21	119	7.58	m	2	12	2	1	7.0697
2	29.31	96	8.00	m	1	13	3	1	7.3473
3	42.76	114	8.08	m	2	13	3	2	7.3473
4	30.48	106	7.75	m	2	28	18	6	10.6767
5	29.31	94	7.75	f	1	56	46	28	15.0331
6	26.71	77	8.08	m	1	60	59	29	15.5562
7	30.47	91	8.08	f	1	60	59	31	15.5562
8	32.79	99	7.75	f	2	60	59	23	15.5562
Mean	32.50	99.5	7.88			37.7	31.1	15.1	11.7678
S.D.	5.35	13.4	.20			23.3	27.1	13.8	4.0719

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	26.71	97	8.08	m	2	16	6	2	8.1231
10	29.43	102	8.08	f	2	18	8	1	8.6015
11	31.30	84	8.17	f	1	22	12	6	9.4862
12	30.60	98	8.25	f	1	54	44	4	14.7647
13	29.31	107	7.50	m	2	60	59	32	15.5562
14	29.31	114	7.33	f	2	60	59	32	15.5562
15	34.38	89	7.50	f	1	60	59	26	15.5562
16	40.05	83	7.33	m	1	60	57	13	15.5562
Mean	31.39	96.7	7.78			43.7	38.0	14.5	12.9000
S.D.	4.12	11.0	.40			20.9	24.8	13.4	3.4774

Group Mean	31.95	98.1	7.83			40.7	34.6	14.8	12.3339
S.D.	4.65	11.9	.31			21.6	25.4	13.2	3.7044

Table B8

Subject Data for LoLiN Group

Task dimension = shape

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	29.31	80	8.25	f	2	26	16	9	10.2952
2	39.54	117	7.83	m	1	30	20	10	11.0450
3	29.18	92	8.17	m	2	58	48	16	15.2969
4	29.31	95	7.92	f	2	60	59	28	15.5562
5	30.07	74	8.08	f	2	60	56	27	15.5562
6	42.98	109	7.50	f	1	60	60	25	15.5562
7	43.69	120	8.83	m	1	60	59	29	15.5562
8	45.01	102	7.83	m	1	60	60	60	15.5562
Mean	36.14	98.6	8.05			51.7	47.2	25.5	14.3023
S.D.	7.30	16.6	.39			14.7	18.5	16.1	2.2525

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	29.71	112	7.50	f	1	25	15	6	10.0990
10	31.30	84	7.33	m	2	32	22	14	11.4015
11	45.01	73	8.08	f	2	37	27	11	12.2472
12	26.71	122	7.42	f	1	60	60	26	15.5562
13	29.71	105	7.75	m	1	60	58	29	15.5562
14	30.48	92	8.08	f	2	60	60	31	15.5562
15	30.60	85	8.17	m	2	60	60	33	15.5562
16	42.98	111	8.25	m	1	60	60	26	15.5562
Mean	33.31	98.0	7.82			49.2	45.2	22.0	13.9411
S.D.	6.75	17.0	.37			15.2	20.1	10.2	2.3029
Group Mean	34.72	98.3	7.94			50.5	46.2	23.7	14.1217
S.D.	6.95	16.2	.39			14.5	18.7	13.1	2.2085

Table B9

Subject Data for LoCaI Group

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
Task dimension = shape									
1	45.05	97	8.00	m	1	11	1	1	6.7807
2	42.98	98	7.58	m	1	12	2	1	7.0697
3	30.74	90	8.08	m	1	13	3	2	7.3473
4	40.68	85	7.83	m	1	26	16	7	10.2952
5	29.92	118	8.25	f	2	27	17	10	10.4877
6	29.26	103	8.00	m	2	60	58	28	15.5562
7	29.71	112	8.17	m	2	60	58	20	15.5562
8	30.08	99	7.50	m	2	60	59	33	15.5562
Mean	34.80	100.2	7.93			33.6	26.7	12.7	11.0811
S.D.	6.82	10.8	.27			22.7	26.8	12.7	3.9565
Task dimension = colour									
9	45.01	120	7.50	f	1	12	2	1	7.0697
10	29.31	78	7.83	f	2	16	6	3	8.1231
11	29.18	95	7.67	f	2	20	10	5	9.0547
12	35.80	108	7.92	f	1	32	22	10	11.4015
13	28.22	62	8.67	m	2	60	59	30	15.5562
14	29.31	91	6.92	f	2	60	57	24	15.5562
15	33.49	100	8.25	m	1	60	60	31	15.5562
16	42.98	119	8.25	m	1	60	59	29	15.5562
Mean	34.16	96.6	7.88			40.0	34.4	16.6	12.2342
S.D.	6.61	19.9	.54			22.1	26.7	13.1	3.7515
Group Mean	34.48	98.4	7.90			36.8	30.6	14.7	11.6577
S.D.	6.50	15.6	.41			21.9	26.2	12.6	3.7719

Table B10

Subject Data for LoLiI Group

Task dimension = shape

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	34.63	89	8.00	f	2	12	2	1	7.0697
2	28.22	131	7.83	m	1	18	8	4	8.6015
3	26.71	113	7.92	m	1	27	17	12	10.4877
4	32.17	84	8.58	f	2	35	25	13	11.9161
5	28.11	106	7.67	m	1	60	59	33	15.5562
6	29.31	100	9.08	f	1	60	58	32	15.5562
7	30.74	97	8.25	f	2	60	60	34	15.5562
8	44.32	80	8.08	m	2	60	51	25	15.5562
Mean	31.78	100.0	8.18			41.5	35.0	19.2	12.5375
S.D.	5.66	16.7	.46			20.9	24.6	13.4	3.5138

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	28.22	96	7.42	m	1	10	0	0	6.4789
10	31.28	103	7.75	m	2	11	1	1	6.7807
11	28.93	76	8.33	m	1	13	3	1	7.3473
12	29.31	94	7.83	m	1	13	3	2	7.3473
13	30.47	99	8.25	f	2	17	7	4	8.3657
14	39.82	119	8.00	m	2	27	17	11	10.4877
15	29.43	81	7.50	m	1	60	56	28	15.5562
16	32.79	99	8.25	m	2	60	60	35	15.5562
Mean	31.28	95.9	7.92			26.4	18.4	10.2	9.7400
S.D.	3.74	13.2	.35			21.4	25.0	13.7	3.7975
Group Mean	31.53	97.9	8.05			33.9	26.7	14.7	11.1387
S.D	4.65	14.7	.42			21.9	25.5	13.9	3.8182

Table B11

Subject Data for HiCaN Group

Task dimension = shape

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	68.80	112	8.25	f	2	10	0	0	6.4789
2	76.01	87	7.50	m	1	11	1	1	6.7807
3	68.80	131	8.00	f	2	17	7	3	8.3657
4	62.04	116	7.83	m	2	19	9	5	8.8310
5	76.01	101	7.92	m	1	39	29	4	12.5696
6	67.28	121	8.00	m	2	60	59	33	15.5562
7	75.16	115	8.08	m	1	60	57	30	15.5562
8	76.01	110	7.50	f	1	60	60	32	15.5562
Mean	71.26	111.6	7.88			34.5	27.7	13.5	11.2118
S.D.	5.29	13.2	.27			22.9	27.1	15.1	4.0403

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	75.49	116	8.00	m	2	10	0	0	6.4789
10	61.99	128	8.00	f	1	12	2	1	7.0697
11	63.76	111	7.33	f	1	14	4	1	7.6147
12	75.49	122	7.33	m	2	15	5	4	7.8730
13	76.01	133	8.25	m	2	16	6	4	8.1231
14	75.57	119	7.50	f	2	20	10	6	9.0547
15	63.02	88	8.08	m	1	60	60	33	15.5562
16	68.80	104	8.08	m	1	60	59	35	15.5562
Mean	70.02	115.1	7.82			25.9	18.2	10.5	9.6658
S.D.	6.33	14.3	.37			21.3	25.6	14.6	3.7122
Group Mean	70.64	113.4	7.85			30.1	23.0	12.0	10.4388
S.D.	5.67	13.4	.31			21.8	25.9	14.5	3.8323

Table B12

Subject Data for HiLiN Group

Task dimension = shape.

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	75.57	104	7.42	m	2	11	11	1	6.7807
2	74.27	138	7.42	f	1	15	5	4	7.8730
3	62.04	126	8.25	f	1	16	6	2	8.1231
4	61.75	102	7.83	f	1	18	8	3	8.6015
5	75.57	113	7.33	f	2	26	16	7	10.2952
6	75.49	85	7.83	m	2	27	17	12	10.4877
7	70.94	114	7.42	m	1	50	40	24	14.2125
8	75.16	97	7.50	f	2	60	59	27	15.5562
Mean	71.35	109.9	7.62			27.9	19.0	10.0	10.2412
S.D.	6.03	16.7	.32			17.8	20.2	10.2	3.1360

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	76.01	119	7.83	m	1	16	6	2	8.1231
10	72.87	109	7.42	f	2	31	21	11	11.2247
11	75.42	116	8.25	f	1	34	24	11	11.7471
12	67.28	96	7.67	m	2	40	30	16	12.7277
13	62.04	79	8.17	m	2	42	32	14	13.0381
14	74.27	102	8.25	f	2	42	32	18	13.0381
15	75.57	136	7.83	f	1	60	53	22	15.5562
16	76.01	126	8.08	m	1	60	60	33	15.5562
Mean	72.43	110.4	7.94			40.6	32.2	15.9	12.6264
S.D.	5.12	18.0	.30			14.6	17.3	9.1	2.4064
Group Mean	71.89	110.1	7.78			34.2	25.6	12.9	11.4338
Group S.D.	5.43	16.8	.34			17.1	19.4	9.8	2.9680

Table B13

Subject Data for HiCaI Group

Task dimension = shape

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	76.44	119	7.75	m	2	11	1	1	6.7807
2	67.28	104	8.25	m	2	14	4	3	7.6147
3	75.41	120	7.42	m	1	38	28	15	12.4094
4	75.16	82	8.00	m	1	46	36	16	13.6380
5	67.28	99	8.25	f	2	59	49	24	15.4271
6	74.27	109	7.67	m	2	60	59	29	15.5562
7	76.01	131	7.92	f	1	60	60	26	15.5562
8	76.44	139	7.67	f	1	60	59	28	15.5562
Mean	73.54	112.9	7.87			43.5	37.0	17.7	12.8173
S.D.	3.93	18.3	.29			20.8	24.2	11.0	3.6579

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	70.14	114	7.92	f	2	11	1	1	6.7807
10	75.41	109	7.92	m	1	17	7	3	8.3657
11	75.57	114	7.50	m	1	20	10	8	9.0547
12	74.27	126	7.67	m	2	25	15	6	10.0990
13	73.22	121	7.75	f	2	33	23	8	11.5756
14	74.46	112	7.58	f	2	45	35	18	13.4905
15	75.41	86	8.00	m	1	45	35	16	13.4905
16	75.41	99	8.25	f	1	60	59	30	15.5562
Mean	74.24	110.1	7.82			32.0	23.1	11.2	11.0516
S.D.	1.84	12.6	.25			16.8	19.1	9.6	2.9955
Group Mean	73.89	111.5	7.84			37.7	30.1	14.5	11.9345
S.D.	2.99	15.2	.26			19.2	22.3	10.5	3.3561

Table B14

Subject Data for HiLiI Group

Task dimension = shape

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
1	76.01	123	8.00	m	2	10	0	0	6.4789
2	76.44	116	7.92	f	2	29	19	8	10.8624
3	75.49	119	7.83	m	2	38	28	15	12.4094
4	76.01	133	7.58	f	2	42	32	17	13.0381
5	62.04	91	7.92	m	1	60	60	26	15.5562
6	66.79	109	7.83	f	1	60	60	30	15.5562
7	68.80	112	7.92	m	1	60	59	22	15.5562
8	68.80	102	7.33	f	1	60	59	32	15.5562
Mean	71.30	113.1	7.79			44.9	39.6	18.7	13.1267
S.D.	5.44	12.9	.22			18.7	23.2	11.0	3.2393

Task dimension = colour

S	SES	IQ	CA	Sex	Cue	TTC	TLE	TNE	SRT
9	68.80	116	8.25	f	1	10	0	0	6.4789
10	68.80	136	8.83	m	1	15	5	2	7.8730
11	75.16	125	7.75	m	1	19	9	4	8.8310
12	76.01	90	7.58	f	1	34	24	19	11.7471
13	67.50	114	8.00	f	2	60	57	28	15.5562
14	75.41	85	7.92	f	2	60	60	32	15.5562
15	75.49	111	7.92	f	2	60	59	37	15.5562
16	76.69	102	7.83	f	2	60	59	32	15.5562
Mean	72.98	109.9	8.01			39.7	34.1	19.2	12.1443
S.D.	3.87	17.1	.38			22.7	27.2	15.2	3.9287
Group Mean	72.14	111.5	7.90			42.3	36.9	19.0	12.6355
S.D.	4.64	14.7	.32			20.2	24.6	12.8	3.5152

Table B15

Summary of Five-way Analysis of Variance

with Dependent Variable TLE

Source	df	MS	F	
A (SES)	1	1012.50	2.04	
B (Reinf.)	1	595.12	1.20	
C (Instrn.)	1	55.12	.11	
D (TD)	1	195.03	.39	
E (Cue)	1	413.28	.83	
AxB	1	5.28	.01	
AxC	1	3507.03	7.06	P < .01
AxD	1	66.12	.13	
AxE	1	480.50	.97	
BxC	1	258.78	.52	
BxD	1	2.00	.00	
BxE	1	561.12	1.13	
CxD	1	648.50	1.38	
CxE	1	1568.00	3.16	
DxE	1	258.78	.52	
AxBxC	1	780.12	1.57	
AxBxD	1	2064.03	4.16	P < .05
AxBxE	1	1164.03	2.34	
AxCxD	1	42.78	.09	
AxCxE	1	472.78	.95	
AxDxE	1	1300.50	2.62	
BxCxD	1	442.53	.89	
BxCxE	1	520.03	1.05	
BxDxE	1	1596.12	3.21	
CxDxE	1	648.00	1.30	
AxBxCxD	1	.50	.00	
AxBxCxE	1	264.50	.53	
AxBxDxE	1	140.28	.28	
AxCxDxE	1	3591.28	7.23	P < .01
BxCxDxE	1	2907.03	5.85	P < .05
AxBxCxDxE	1	72.00	.14	
Error	96	496.72		

Table B16

Summary of Five-way Analysis of Variance

with Dependent Variable TNE

Source	df	MS	F	
A (SES)	1	182.88	1.24	
B (Reinf.)	1	416.88	2.82	
C (Instrn.)	1	.63	.00	
D (TD)	1	76.57	.52	
E (Cue)	1	67.57	.47	
AxB	1	25.38	.17	
AxC	1	625.70	4.23	$P < .05$
AxD	1	18.76	.13	
AxE	1	73.51	.50	
BxC	1	56.45	.38	
BxD	1	.01	.00	
BxE	1	96.26	.65	
CxD	1	48.76	.33	
CxE	1	388.51	2.63	
DxE	1	267.38	1.81	
AxBxC	1	309.38	2.09	
AxBxD	1	500.07	3.38	
AxBxE	1	431.45	2.92	
AxCxD	1	31.01	.21	
AxCxE	1	86.13	.58	
AxDxE	1	33.01	.22	
BxCxD	1	70.51	.48	
BxCxE	1	25.38	.17	
BxDxE	1	548.63	3.71	
CxDxE	1	18.76	.13	
AxBxCxD	1	33.01	.22	
AxBxCxE	1	23.63	.16	
AxBxDxE	1	61.88	.42	
AxCxDxE	1	1332.57	9.01	$P < .01$
BxCxDxE	1	745.95	5.04	$P < .05$
AxBxCxDxE	1	2.26	.02	
Error	96	147.93		

Table B17

Summary of Five-way Analysis of Variance

with Dependent Variable SRT

Source	df	MS	F	
A (SES)	1	15.79	1.50	
B (Reinf.)	1	17.58	1.67	
C (Instrn.)	1	1.85	.18	
D (TD)	1	3.87	.37	
E (Cue)	1	4.98	.47	
AxB	1	.36	.03	
AxC	1	80.81	7.68	P< .01
AxD	1	.54	.05	
AxE	1	10.08	.96	
BxC	1	13.53	1.29	
BxD	1	.27	.03	
BxE	1	19.81	1.88	
CxD	1	18.02	1.71	
CxE	1	33.84	3.22	
DxE	1	5.96	.57	
AxBxC	1	8.10	.77	
AxBxD	1	51.60	4.91	P< .05
AxBxE	1	24.22	2.30	
AxCxD	1	.69	.07	
AxCxE	1	11.53	1.10	
AxDxE	1	31.76	3.02	
BxCxD	1	15.71	1.49	
BxCxE	1	13.82	1.31	
BxDxE	1	30.47	2.90	
CxDxE	1	9.89	.94	
AxBxCxD	1	.24	.02	
AxBxCxE	1	8.34	.79	
AxBxDxE	1	1.13	.11	
AxCxDxE	1	61.89	5.88	P< .05
BxCxDxE	1	49.42	4.70	P< .05
AxBxCxDxE	1	.12	.01	
Error	96	10.52		

Table B18

Summary of Four-way Analysis of Variance

with Dependent Variable TLE

Source	df	MS	F	
A (SES)	1	1012.50	1.78	
B (Reinf.)	1	595.12	1.05	
C (Instrn.)	1	55.12	.10	
D (TD)	1	195.03	.34	
AxB	1	5.28	.01	
AxC	1	3507.03	6.17	$P < .05$
AxD	1	66.12	.12	
BxC	1	258.78	.46	
BxD	1	2.00	.00	
CxD	1	648.50	1.20	
AxBxC	1	780.12	1.37	
AxBxD	1	2064.03	3.63	
AxCxD	1	42.78	.08	
BxCxD	1	442.53	.78	
AxBxCxD	1	.50	.00	
Error	112	568.24		

Table B19

Summary of Four-way Analysis of Variance

with Dependent Variable TNE

Source	df	MS	F	
A (SES)	1	182.88	1.11	
B (Reinf.)	1	416.88	2.54	
C (Instrn.)	1	.63	.00	
D (TD)	1	76.57	.47	
AxB	1	25.38	.15	
AxC	1	625.70	3.81	P = .053
AxD	1	18.76	.11	
BxC	1	56.45	.34	
BxD	1	.01	.00	
CxD	1	48.76	.30	
AxBxC	1	309.38	1.88	
AxBxD	1	500.07	3.04	
AxCxD	1	31.01	.19	
BxCxD	1	70.51	.43	
AxBxCxD	1	33.01	.20	
Error	112	164.32		

Table B20

Summary of Four-way Analysis of Variance

with Dependent Variable SRT

Source	df	MS	F	
A (SES)	1	15.79	1.33	
B (Reinf.)	1	17.58	1.48	
C (Instrn.)	1	1.85	.16	
D (TD)	1	3.87	.33	
AxB	1	.36	.03	
AxC	1	80.81	6.82	$P < .05$
AxD	1	.54	.05	
BxC	1	13.53	1.14	
BxD	1	.27	.02	
CxD	1	18.02	1.52	
AxBxC	1	8.10	.68	
AxBxD	1	51.60	4.36	$P < .05$
AxCxD	1	.69	.06	
BxCxD	1	15.71	1.33	
AxBxCxD	1	.24	.02	
Error	112	11.85		

Table B21

Summary of Three-way Analysis of Variance

with Dependent Variable TLE

Source	df	MS	F	
A (SES)	1	1012.50	1.81	
B (Reinf.)	1	595.12	1.06	
C (Instrn.)	1	55.12	.10	
AxB	1	5.28	.01	
AxC	1	3507.03	6.27	P <.05
BxC	1	258.78	.46	
AxBxC	1	780.12	1.39	
Error	120	559.51		

Table B22

Summary of Three-way Analysis of Variance

with Dependent Variable TNE

Source	df	MS	F	
A (SES)	1	182.88	1.14	
B (Reinf.)	1	416.88	2.61	
C (Instrn.)	1	.63	.00	
AxB	1	23.38	.16	
AxC	1	625.70	3.91	$P < .05$
BxC	1	56.44	.35	
AxBxC	1	309.38	1.94	
Error	120	159.86		

Table B23

Summary of Three-way Analysis of Variance

with Dependent Variable SRT

Source	df	MS	F	
A (SES)	1	15.79	1.34	
B (Reinf.)	1	17.58	1.49	
C (Instrn.)	1	1.85	.16	
AxB	1	.37	.03	
AxC	1	80.81	6.84	$P < .05$
BxC	1	13.53	1.14	
AxBxC	1	8.10	.69	
Error	120	11.82		

Table B24

Summary of Three-way Analysis of Covariance

with Dependent Variable TLE

and Covariate IQ

Source	df	MS	F	
A (SES)	1	145.06	< 1	
B (Reinf.)	1	536.12	< 1	
C (Instrn.)	1	58.06	< 1	
AxB	1	1.62	< 1	
AxC	1	3489.06	6.33	P < .05
BxC	1	230.94	< 1	
AxBxC	1	856.94	1.56	
Error	119	550.88		

Table B25

Summary of Three-way Analysis of Covariance

with Dependent Variable TLE

and Covariate CA

Source	df	MS	F	
A (SES)	1	904.94	1.61	
B (Reinf.)	1	541.12	<1	
C (Instrn.)	1	75.19	<1	
AxB	1	12.00	<1	
AxC	1	3540.56	6.29	P<.05
BxC	1	282.31	<1	
AxBxC	1	757.69	1.35	
Error	119	562.98		

Table B26

Summary of Three-way Analysis of Covariance

with Dependent Variable TLE

and Covariates IQ and CA

Source	df	MS	F	
A (SES)	1	128.11	<1	
B (Reinf.)	1	498.67	<1	
C (Instrn.)	1	72.54	<1	
AxB	1	4.52	<1	
AxC	1	3513.29	6.33	P<.05
BxC	1	247.42	<1	
AxBxC	1	837.92	1.51	
Error	118	554.89		

Table B27

Summary of Three-way Analysis of Covariance

with Dependent Variable TNE

and Covariate IQ

Source	df	MS	F	
A (SES)	1	15.02	<1	
B (Reinf.)	1	391.82	2.48	
C (Instrn.)	1	.80	<1	
AxB	1	30.70	<1	
AxC	1	621.91	3.94	P<.05
BxC	1	49.97	<1	
AxBxC	1	333.33	2.11	
Error	119	157.88		

Table B28

Summary of Three-way Analysis of Covariance

with Dependent Variable TNE

and Covariate CA

Source	df	MS	F	
A (SES)	1	165.21	1.03	
B (Reinf.)	1	397.86	2.47	
C (Instrn.)	1	1.64	<1	
AxB	1	20.84	<1	
AxC	1	631.04	3.92	P<.05
BxC	1	60.55	<1	
AxBxC	1	303.87	1.89	
Error	119	161.02		

Table B29

Summary of Three-way Analysis of Covariance

with Dependent Variable TNE

and Covariates IQ and CA

Source	df	MS	F	
A (SES)	1	13.20	<1	
B (Reinf.)	1	379.34	2.38	
C (Instrn.)	1	1.45	<1	
AxB	1	27.20	<1	
AxC	1	625.25	3.93	$P<.05$
BxC	1	52.46	<1	
AxBxC	1	329.16	2.07	
Error	118	159.15		

Table B30

Summary of Three-way Analysis of Covariance

with Dependent Variable SRT

and Covariate IQ

Source	df	MS	F	
A (SES)	1	.65	<1	
B (Reinf.)	1	15.89	1.37	
C (Instrn.)	1	1.95	<1	
AxB	1	.17	<1	
AxC	1	80.34	6.96	$P<.01$
BxC	1	12.44	1.08	
AxBxC	1	9.46	<1	
Error	119	11.54		

Table B31

Summary of Three-way Analysis of Covariance

with Dependent Variable SRT

and Covariate CA

Source	df	MS	F	
A (SES)	1	13.93	1.17	
B (Reinf.)	1	16.24	1.37	
C (Instrn.)	1	2.36	<1	
AxB	1	.59	<1	
AxC	1	81.52	6.86	$P<.01$
BxC	1	14.26	1.20	
AxBxC	1	7.78	<1	
Error	119	11.89		

Table B32

Summary of Three-way Analysis of Covariance

with Dependent Variable SRT

and Covariates IQ and CA

Source	df	MS	F	
A (SES)	1	.51	< 1	
B (Reinf.)	1	15.01	1.29	
C (Instrn.)	1	2.29	< 1	
AxB	1	.29	< 1	
AxC	1	80.82	6.95	P < .01
BxC	1	12.92	1.11	
AxBxC	1	9.20	< 1	
Error	118	11.63		